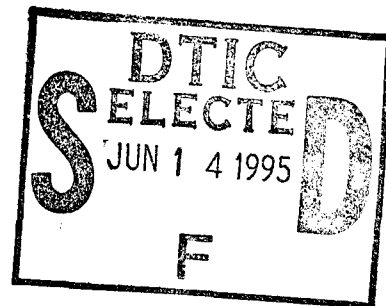


NAVAL POSTGRADUATE SCHOOL MONTEREY, CALIFORNIA



THESIS

AN EXAMINATION OF DEPARTMENT OF
DEFENSE RISK MANAGEMENT POLICY FOR
NONDEVELOPMENTAL ITEMS ACQUISITION
PROGRAMS

by

Michael R. Steves

March, 1995

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MANAGEMENT POLICY FOR NONDEVELOPMENTAL ITEMS
ACQUISITION PROGRAMS

by

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ABSTRACT

Non-developmental Items (NDI) acquisition programs are enjoying popular support as faster, cheaper alternatives to full-scale development programs. Unfortunately, DOD policy with respect to risk management in NDI programs is lacking. Tailoring DOD risk management policy to support NDI program management leaves the program manager (PM) much guess-work. A NDI PM's risk management program cannot reasonably benefit from DOD risk management guidance, procedures, and risk management tools because they are oriented to developmental program risks and risk management practices. Missing is any explicit consideration of the unique risks and risk management requirements in NDI programs. NDI PMs need more explicit guidance in policy and instruction regarding NDI risk management in the streamlined, accelerated NDI environment. This need is brought out in a case study of the Forward Area Air Defense Sensors Product Office which attempts to implement sound risk management into its NDI products without the benefit of definitive NDI risk identification, assessment, or response policy material. A lesson learned is the need for a published Risk Management Plan as the source of NDI risk management program decisions and actions. Specific recommendations are contained for inclusion in DOD policy with respect to NDI risk management.

TABLE OF CONTENTS

I.	INTRODUCTION	1
A.	BACKGROUND	1
B.	OBJECTIVE	2
C.	RESEARCH QUESTIONS	3
D.	SCOPE	3
E.	LITERATURE REVIEW AND METHODS	4
F.	DEFINITIONS AND ACRONYMS	6
G.	CHAPTER OUTLINE	6
II.	RISK MANAGEMENT OVERVIEW	9
A.	PURPOSE	9
B.	THE DEFINITION OF RISK	9
C.	RISK MANAGEMENT	10
D.	IMPLEMENTING RISK MANAGEMENT	11
	1. Program Risk Identification	12
	2. Program Risk Assessment	12
	3. Risk Response	14
	4. Risk Data Collection, Application, and Documentation	15
E.	RISK MANAGEMENT IN THE DEPARTMENT OF DEFENSE .	15
	1. Risk Definition	15
	2. Risk Management	17
	3. The Defense Risk Management Process . . .	18
F.	DOD RISK MANAGEMENT POLICIES	21
G.	U.S. ARMY RISK MANAGEMENT POLICIES	22
H.	SUMMARY	23
III.	RISK MANAGEMENT IN NDI ACQUISITIONS	25
A.	PURPOSE AND BACKGROUND	25
B.	THE DEFINITION OF NDI	25
C.	USING NDI FOR REDUCING PROGRAM RISKS	27
D.	NDI BENEFITS AND POTENTIAL RISKS	28

1.	Benefits	28
a.	Time	28
b.	Cost	29
c.	Technical Performance	29
d.	Risk Reduction	29
e.	Contracting	29
2.	Potential Risks	30
a.	Requirements	31
b.	NDI Acquisition Management Environment	32
c.	Specifications and Standards	34
d.	Test and Evaluation	36
e.	Integrated Logistics Support	37
E.	NDI ACQUISITION POLICY	40
1.	DOD DIRECTIVE 5000.1	40
2.	Government Policy	40
F.	IMPLICATIONS OF RISK MANAGEMENT POLICY FOR NDI ACQUISITION PROGRAMS	41
G.	SUMMARY	44
IV.	THE FAAD SENSORS CASE	45
A.	PURPOSE	45
B.	EARLY WARNING OVERVIEW AND FAAD ACQUISITION IMPLICATIONS	45
1.	The FAAR and FAAD Doctrine	45
2.	Acquisition Implications	47
C.	THE GROUND BASED SENSOR (GBS)	48
1.	GBS System Overview	48
2.	The GBS Acquisition Strategy	49
D.	THE LIGHT AND SPECIAL DIVISION INTERIM SENSOR (LSDIS)	51
1.	LSDIS System Overview	51
2.	The LSDIS Acquisition Strategy	52
E.	RISKS AND RISK PERCEPTIONS IN THE FAADS SENSORS	

PROGRAMS	54
1. GBS Acquisition Program	54
a. Technical Risks	54
b. Cost Risks	55
c. Schedule Risks	56
d. Supportability Risks	56
2. LSDIS Acquisition Program	57
a. Technical Risks	57
b. Cost Risks	57
c. Schedule Risks	59
d. Supportability Risks	59
F. THE FAAD SENSORS RISK MANAGEMENT PROGRAM . . .	59
1. FAAD Risk Management and DOD Policies . .	59
2. The GBS Risk Management Program	62
3. The LSDIS Risk Management Program	65
4. The FAAD Sensors Risk Management Plans .	68
G. SUMMARY	69
V. MERGING THE TWO PATHS INTO ONE	71
A. PURPOSE	71
B. FAAD SENSORS LESSONS LEARNED IN RISK MANAGEMENT	71
C. THE DIVERGING PATHS	76
D. A DENDRITIC APPROACH	77
E. DOD POLICY REVISIONS	78
1. DODD 5000.1 Risk Management Policy . . .	80
2. DODI 5000.2 Risk Management Policy . . .	84
3. DODI 5000.2 Risk Management Procedures .	85
F. DOD 4245.7-M TEMPLATES IMPROVEMENTS	86
1. Requirements Risks	87
2. Requirements Risk Template	88
3. Specifications and Standards Risks . . .	88
4. Specifications and Standards Risk Template	89

5.	NDI Acquisition Management	90
6.	NDI Acquisition Management Risk Template	91
7.	Test and Evaluation	92
8.	Test and Evaluation Risk Template	92
9.	Integrated Logistics Support	93
10.	Integrated Logistics Support Risk Template	94
G.	SUMMARY	94
VI.	SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS	97
A.	SUMMARY	97
B.	CONCLUSIONS	97
C.	RECOMMENDATIONS	98
D.	AREAS FOR FURTHER RESEARCH	99
	LIST OF REFERENCES	103
	INITIAL DISTRIBUTION LIST	

I. INTRODUCTION

A. BACKGROUND

Today's era of defense downsizing has the military services scrambling to protect research and development funds and to preserve their acquisition programs. Quality of life, training, sustainment, and readiness issues continue to siphon funds away from research, development, and acquisition (RD&A) programs. The Services and their acquisition program managers (PMs) are hard-pressed to find ways to reduce development costs and program duration while optimizing new system performance and support capabilities. In these lean times, program management mistakes and problem-plagued acquisition strategies can often lead to program cancellation. Program risks must be carefully managed to prevent unanticipated or poorly planned-for events from making a program vulnerable to funding cuts or elimination.

To the rescue, or so many hope, comes the Non-developmental Item (NDI). NDI system acquisitions give PMs and the Government greater access to technology. NDI acquisitions benefit industry by broadening the U.S. Defense Technology and Industrial Base (DTIB), increasing the number of defense contractors available to offer products to the Department of Defense (DOD), and providing more extensive surge capability upon mobilization of the defense industry (Gansler, p. 110, 1994). Acquisition strategies based on these lower-cost, shorter-duration alternatives to the traditional, full-scale development programs offer the promise of effective risk mitigation and program success. NDIs seemingly offer the ideal, low-risk solution of state-of-the-art technological capabilities that can meet the Services' urgent mission needs and operational requirements.

NDI program management, however, is not without its own risks. A PM must tailor a program's risk management to the

unique risks and uncertainties in a NDI system acquisition. Tailoring is a practice that means modifying the acquisition process as needed to achieve favorable program results (DOD Instruction (DODI) 5000.2, p. 2-6, 1991). The concept of tailoring risk management is valuable as part of the PM's program authority. The problems arise in the implementation of tailored risk management programs, particularly when considering NDIs.

Risk management in NDI acquisition programs requires more than tailoring. It demands policy, framework, and format to assist the program manager. The purpose of using a NDI acquisition strategy is to simplify and speed the acquisition process to meet a program's, and ultimately, the soldier's needs. NDI acquisition is an approach that requires supportive risk management policy structure, rather than implicit expectations of tailoring, to fulfill its promise of simple, rapid, and reduced-risk acquisitions.

B. OBJECTIVE

The objective of this thesis is to examine risk management in NDI acquisition programs. It will consist of DOD risk management and NDI policy reviews from an Army air defender's point of view. Risk management concepts and practices will be explored first to set the stage for defense risk management. DOD risk management policies will be assessed to determine their applicability and support of NDI risk management programs. This thesis will then use the Ground Based Sensor (GBS) and the Light and Special Division Interim Sensor (LSDIS) acquisitions managed by the Forward Area Air Defense (FAAD) Sensors Program Office to demonstrate how risk management is currently practiced by an Air Defense Artillery (ADA) systems program office. The result of this examination will be recommendations for risk management policies and processes focused on NDI system acquisitions.

C. RESEARCH QUESTIONS

The primary research question of this thesis is:
How does DOD risk management policy address NDI acquisitions and how does it support NDI acquisition programs such the Forward Area Air Defense Early Warning Sensors Program?

Subsidiary Research Questions supporting this issue are:

1. What is risk management?
2. What are the current DOD and Army risk management policies and how do they address NDI acquisitions?
3. What are the risks associated with NDI acquisitions?
4. What were the risks involved with the GBS and LSDIS tactical early warning sensor acquisitions?
5. What was the risk management approach for GBS and LSDIS and how consistent was the FAAD Sensor program's risk management effort in complying with DOD and Army risk management policies? What problems were encountered in complying with risk management policies?
6. What improvements can be made to DOD risk management policy to enhance NDI risk management planning and execution in future NDI acquisitions?

D. SCOPE

This thesis encompasses risk management policy as it applies to NDI acquisitions. It examines the current structure of risk management in DOD and the U.S. Army. It considers the unique uncertainties and risk in NDI programs. It explores whether the intent of using NDI acquisitions as a risk management measure accomplishes its purpose. It focuses on the efforts of a NDI Air Defense system program management office (PMO) to manage its program and its program risks in an era of scarce resources and broad risk management policy. It is not meant to be a technical examination of the GBS or LSDIS

systems capabilities nor a comprehensive evaluation of their acquisition strategies or plans. It will explore the treatment of aspects of risk within those documents but will not cover classified material. This research does not contain material from the Army's risk management handbook (Department of the Army Pamphlet 70-2) scheduled to be published in February 1995. This examination assumes a working knowledge of a system acquisition life cycle.

E. LITERATURE REVIEW AND METHODS

The literature search to support this effort is driven by first-hand training experiences by the thesis author. The starting point for this analysis comes from the Defense Systems Management College (DSMC) Risk Management, NDI Acquisition, Systems Engineering, and Commercial Practices publications, ADA Magazine articles on GBS and LSDIS, Program Manager Magazine articles on risk management, and the Air Force Acquisition Model (AFAM) materials relating to risk management. This is complemented by the Program Management Institute's (PMI) guidelines for commercial program risk management which provide developed risk management theory. Journal articles and technical reports examining risk management and NDI acquisitions were obtained from the Defense Logistics Systems Information Exchange (DLSIE) and the Defense Technical Information Center (DTIC). The FAAD Sensors Program Office, Assistant Program Executive Office for ADA Integration, and the Contracting Directorate at Redstone Arsenal, Alabama provided FAAD Sensors acquisition and risk management documents and data. The TRADOC Systems Manager (TSM) for Early Warning Sensors and the Directorate for Combat Developments (DCD) at Ft. Bliss, Texas assisted by providing material on GBS and LSDIS fielding.

The risk management materials for this research are augmented with face-to-face interviews with experts at

Redstone Arsenal and Fort Bliss working with GBS and LSDIS acquisitions. Additional data came from telephone discussions with those same experts. The interviews solicited views and opinions on the GBS and LSDIS NDI acquisition strategies, their risk management programs, issues affecting NDI acquisitions, and their associated risks. Thesis travel occurred 14-18 June 1994 to conduct the personal interviews and discussions with these sources.

The method this thesis employs is to familiarize the reader with risk management and NDI concepts and the DOD policies pertaining to them. It includes a review of existing risk management policies and procedures published and cited by defense sources. It progresses to a specific NDI program case analysis. DOD and Army risk management guidelines are examined through the case study of two ADA NDI acquisitions. The case reviews how DOD policy was implemented and to what extent the policy supports NDI acquisition program managers. The steps used to research and analyze this thesis topic consist of the following:

1. A familiarization and study of risk management concepts using the Program Management Institute's body of knowledge pertaining to project risk management.
2. An examination of defense risk management and risk management policy. It is complemented by the DSMC publication on risk management. DOD Acquisition policy from the 5000.-series and Army risk management regulations provide sources for this step.
3. An assessment of the support and effect of these policies on NDI program management using the DSMC publication on NDI acquisitions and the above-mentioned references.
4. An assessment of tailoring developmental risk management policy in support of NDI acquisition programs.

5. An analysis of a case. The case examines the experience of the FAAD Sensors PMO using DOD risk management policies and practices in its program management of the GBS and LSDIS. The basis for this case is face-to-face and telephone interviews with past and present FAAD Sensors officials using a prepared set of questions on the FAAD Sensors program and risk management.
6. Instruments of measurement for this thesis are templates from DOD Publication 4245.7-M, the risk assessment formats found in DOD 5000.2-M, and the risk management plan cited in the DSMC risk management publication. A dendritic diagram will depict the differences in developmental item and NDI risk management policy. This may be valuable not only to the GBS and LSDIS case but for NDI acquisition programs overall.
7. Based on case analysis and policy assessment, a series of recommendations and conclusions emerge to aid future NDI PMs. The usefulness of NDI-based risk templates and NDI-oriented risk management policy will be included as the basis for these recommendations.

F. DEFINITIONS AND ACRONYMS

Definitions and acronyms common to DOD, the U.S. Army, and civilian program management are noted throughout this thesis.

G. CHAPTER OUTLINE

This thesis investigates the use of risk management programs and policies for NDI acquisitions.

Chapter I introduces the background and focus of research. It examines today's constrained resources which complicate the acquisition and environment and support the appeal of NDI solutions. It considers the incentives for risk management and the unforgiving acquisition climate in which

risk management has become a must.

Chapter II serves as an overview to define and describe risk and risk management concepts. This risk management "primer", based on the PMI body of knowledge, then narrows to consider defense-unique details of risk management. It introduces current risk management policy at both DOD and Army level and lays out the general risk management process prescribed for program offices.

Chapter III examines the NDI alternative to full scale development. It discusses the acquisition and risk management policy that is expected to support NDI system acquisition management. It includes consideration of the tailoring involved in NDI risk management. It examines the risks unique to pursuing NDI acquisitions.

Chapter IV relates the events that created the current absence of Early Warning Network (EWN) systems (i.e. GBS and LSDIS) in ADA units. The risks in the GBS and LSDIS acquisitions may or may not be directly associated with the four year delay witnessed in providing initial sensor systems to the users. It provides an overview of the two sensors and considers the risks facing the GBS and LSDIS systems. It reviews the risk management approach for each sensor and presents challenges in mitigating NDI risks using developmental item-based policy, practices, and risk management tools such as the templates found in DOD 4245.7-M.

Chapter V analyzes DOD NDI risk management policy and guidelines. This chapter considers the challenges and potential solutions for effective NDI risk management based on available risk management tools. The tools considered are the DOD 4245.7-M templates and a NDI risk management plan.

Chapter VI makes recommendations and proposes improvements in the content, value, and effectiveness of DOD NDI risk management policies and guidelines for future programs. These emerge from the application of lessons in the

FAAD Sensors case and DOD policy review. The recommendations consist of revisions to risk management policies and practices in NDI acquisitions.

II. RISK MANAGEMENT OVERVIEW

A. PURPOSE

This chapter introduces risk and risk management concepts. This risk management "primer" uses the Program Management Institute's (PMI) body of knowledge on risk management as the source of this basic overview. The PMI approach is representative of the general body of knowledge concerning risk and risk management that may be found in business and industry today. DSMC risk management concepts are subsequently introduced. The chapter then presents DOD and U.S. Army risk management policy which acts as guidance for PMs as they structure their risk management programs.

B. THE DEFINITION OF RISK

What is risk? Before answering this, it is important to understand the role of uncertainty. Uncertainty represents the set of all possible outcomes that are either favorable (opportunities) or unfavorable (risks).¹ The goal of risk management is to move uncertainties in an acquisition program away from the risk end of the uncertainty spectrum and towards the opportunities end.

With this understanding of uncertainty, risk is defined as the cumulative probability of uncertain occurrences adversely affecting a program's objectives. Risk itself consists of three risk factors. These are:

1. Risk Events. These are specific occurrences that can hurt progress in a program. The consequences of these negative events are described predominantly in terms of scope, quality, time, and cost objectives or goals:

- a. Scope Risks are changes in scope to meet

¹ The material presented in this chapter, sections B-F are referenced from Wideman, p.I-2 to p.B-1, 1992 except as noted.

program objectives (e.g. regulatory or work breakdown structure changes). These risks include both ill-defined program plans and requirements.

b. Quality Risks are performance or technical failures. These risks include poor quality assurance and poor workmanship.

c. Schedule Risks are failures in meeting time estimates. These risks consist of poor, premature, or optimistic time estimates, scope changes, and/or accelerated fielding requirements.

d. Cost Risks are failures to achieve desired budget targets. These risks consist of poor, premature, or optimistic cost estimates and/or inadequate cost controls.

The type of acquisition program determines the type of possible risk events witnessed and their influence on a program. Most risks affect more than one program objective with the predominance of risk events affecting the schedule and cost program objectives.

2. Risk Probability. This is the likelihood of occurrence of each of the risk events.

3. Amount at Stake. This represents the severity of the consequences if a particular risk event occurs.

C. RISK MANAGEMENT

Risk management is "the art and science of identifying, assessing, and responding to project risk throughout the life of a project and in the best interests of its objectives" (Wideman, p. II-3, 1992). Risk management is a continuous, integrated process conducted throughout the life of an acquisition program. Its goals are the identification of program risk and the development of risk management strategies to minimize or avoid those risks. Risk management's intent is to aid proactive decision-making through anticipatory planning as opposed to crisis decisionmaking.

D. IMPLEMENTING RISK MANAGEMENT

A program office implements risk management to assist planning and decisionmaking. In doing so, uncertainty, risk, and the amount at stake can be reduced to manageable levels throughout the program life.

Risk management in business stresses four phases: identification, assessment, response, and documentation (see Figure 1 below).

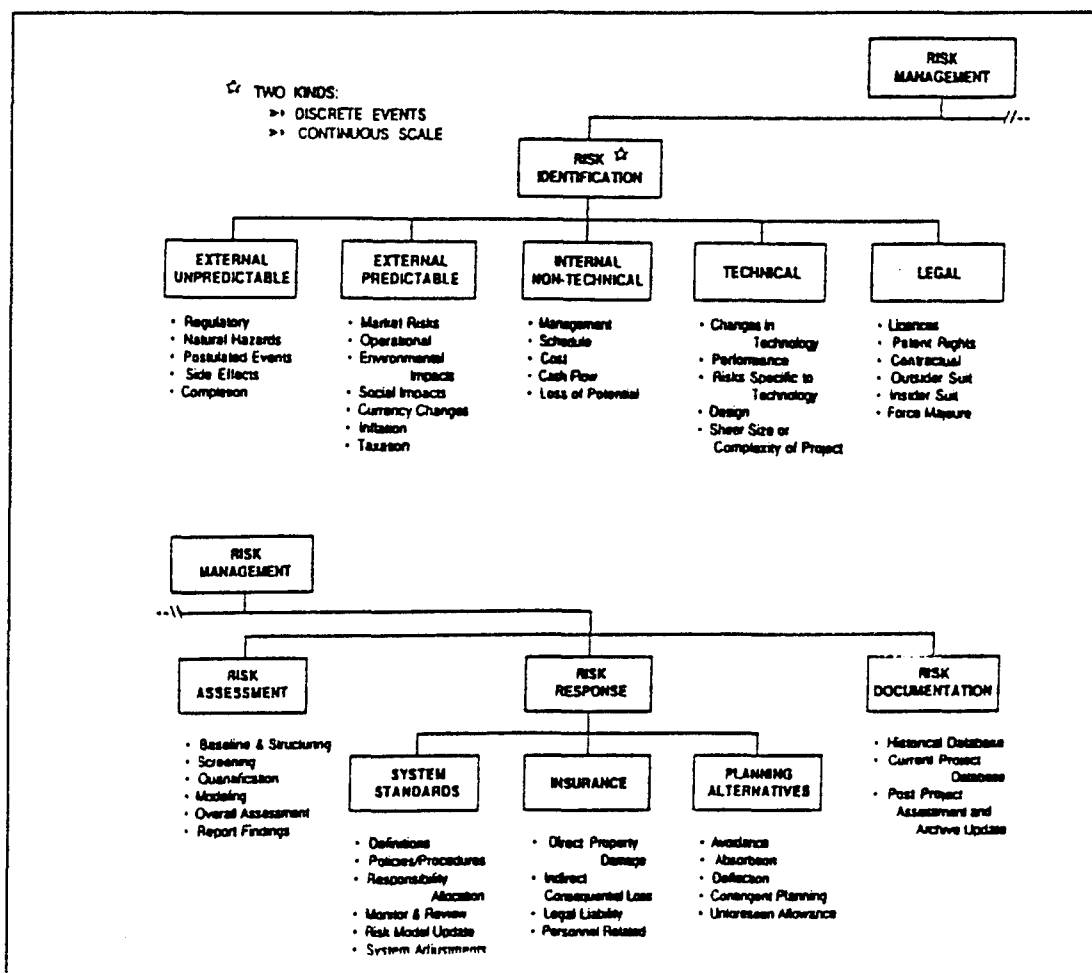


Figure 1 The Four Phases of Risk Management (Source: Wideman, Chapter III, 1992)

1. Program Risk Identification

Risk identification is the identification of specific characteristics thought to contribute to uncertainty in program objectives (Defense Advanced Research Projects Agency, p. 6, 1983). This first phase seeks to identify all the possible risks which may significantly impact a program's success. Examples of sources of risk are: unanticipated Government intervention, unpredicted changes or shifts in economic markets, inappropriate program structure, scheduling delays, unanticipated resource problems, changes in technology, changes in performance requirements or design, increased technical complexity, and contractual difficulties evolving from the type of contract or data rights issues.

Risk identification requires PMs to be familiar with the program's scope, product, and objectives. Risks are matched to the program objectives they affect and then screened by their type and source. Identification should be completed early in a program's life to facilitate informed decisionmaking and provide risk early warning signals. PMs can identify sources of risk and understand them better using a multi-functional team to examine program details and determine their risks and uncertainties. These can then provide PMs initial risk estimates.

2. Program Risk Assessment

Risk assessment is the "examination of program elements, using experts, in order to synthesize a model...(it) is a means of reducing the knowledge of program elements to quantitative expressions of uncertainty" (DSMC, p. II-2, 1983). This phase seeks to analyze the individual elements that create uncertainty or problems, determine the

relationships among those elements, and then formulate a model to study the problem (Ingalls, p.28, 1983). Quantification then follows to develop mathematical descriptions of those relationships posed in the model.

Risk assessment consists of two primary steps: assessing and assigning probabilities to risk events and analyzing the consequences on the project. Assessment includes assigning probabilities to undesired or unfavorable events (risks) and examining their affect on program objectives. This again can effectively be done using a multifunctional team. A risk assessment team rates program risks by type, impact, and probability of occurrence using subjective or quantitative estimates. Risk ratings normally consist of low, medium, and high based on their severity of impact. Risk assessment treats risks as probabilities of unfavorable events that occur within the range of total success and total failure. This range establishes a risk baseline and the ability to benchmark a program's risk status against program objectives over a program's life.

Quantitative risk assessment is called risk analysis. It models and quantifies risk events and their impact on program objectives. Analysis concentrates primarily on medium- and high-rated program risks with the highest likelihood of occurrence. Contingency allowances, such as management reserves, cover risks with lower severity. Together, risk assessment and the risk analysis which supports it provide a risk profile or picture that the PM can use to make informed program decisions.

Risk analysis requires the PM to estimate the degree of uncertainty expected early in a program. This may be done using probability distributions, probability tree diagrams, modeling, or sensitivity analysis (as opposed to simply using subjective assessment or "gut feeling"). Risk analysis modeling techniques that support this phase include

probability distribution analysis, the Delphi Method, Monte Carlo simulations, and decision theory.

Risk analysis should accompany risk assessment early in a program's life cycle and can be tailored to the program. It is an iterative, continuous cycle used to establish or update the risk baseline. Its value is as an integral part of program management planning.

3. Risk Response

Risk response is program manager actions and strategy initiated once risks have been identified and assessed. This phase establishes strategies to effectively handle risk. Responses include:

1. Acceptance. Management takes no action after recognition (management responds by adjusting operations or modifying objectives).
2. Avoidance. Management takes proactive steps, makes contingency plans, or selects lower-risk alternatives.
3. Reduction/Minimization. Management uses alternative approaches such as workarounds or collection of data and information to facilitate contingency planning.
4. Sharing. Management shares risk through joint agreements or contract agreements.
5. Transfer. Management deflects risk via a contract clause, liability or loss insurance, or warranties.
6. Absorption. Management relies on contingency allowances or reserves.

7. A combination of the above methods.

Program managers can hold periodic reviews to monitor changes in program risks and update proposed responses.

4. Risk Data Collection, Application, and Documentation

This final risk management phase builds a reliable database to allow continued risk evaluations for current programs and as reference sources for future programs. Risk management data sources are established through historical databases, current databases, and post-program reviews and archives. These aid the estimation, comparison, updating, and information exchange needs of the program manager. Data-building facilitates and simplifies risk and program decisions particularly when multifunctional teaming and high turnover prevail in a program office.

Risk management is a continuous, iterative process conducted throughout the lifecycle of a system's acquisition. Managing the uncertainties of a program and the consequences of unfavorable events is a difficult task. DOD faces its own acquisition risks. Its risk management approach is the focus of the next section.

E. RISK MANAGEMENT IN THE DEPARTMENT OF DEFENSE

1. Risk Definition

DOD defines risk somewhat differently from the definition presented earlier. The DOD definition considers subjectivity and impacts made on program objectives rather than simply considering its impact on the whole program. It defines risk as "a subjective assessment made regarding the likelihood or

probability of not achieving a specific objective by the time established with the resources provided or requested" (DODI 5000.2, p. 15-15, 1991). Risk is characterized in the following ways:²

a. Technical Risk. This is performance-based risk in the development of a new design for better performance or with new constraints on existing performance. It includes operational capability, reliability, and producibility. Examples relating to technical risk are development and design based on unproven technologies, requirements changes, and/or configuration changes.

b. Supportability Risk. This is performance-based risk in fielding and providing maintenance support to new systems. It results from technical or programmatic risks. Examples include unforeseen training requirements, and/or failure to achieve reliability, availability, and maintainability requirements.

(Technical and Supportability Risk appear to correspond to Performance Risk defined in Section B).

c. Programmatic Risk. This is environment-based risk from the impact of events beyond a PM's control. These include higher level decisions and/or turbulence introduced from outside the program (e.g. Congress) and resource changes that can influence program success. Additional examples are material and personnel shortages or turbulence, contractor instability, and/or funding changes.

(Programmatic Risk appears to correspond to Scope Risk defined in Section B).

d. Cost Risk. This is the risk of cost projections not being realistic or of the program not progressing efficiently to meet established cost objectives. This often

² The material in sections E-H is referenced from DSMC's Risk Management Concepts and Guidance, p.3-4 to p.C-7, 1989 except where noted.

results from sensitivity to technical, supportability, or programmatic risks. Examples are increased overhead rates and cost estimation errors.

e. Schedule Risk. This is the risk of schedule estimates being too optimistic or of the program not developing effectively to achieve established baselines. This often results from sensitivity to technical, cost, supportability, or programmatic risks. Examples include problems resulting from concurrent development and production and schedule estimation errors.

According to the DSMC, technical, supportability, and programmatic risks act as sources of risk while cost and schedule risks are indicators of those sources of unfavorable events. These five types of risk act interdependently to affect a program's performance.

2. Risk Management

DOD defines risk management as "a systematic approach to identifying, analyzing, and controlling areas or events with a potential for causing unwanted change. It is an integral part of the overall program management effort" (PM Notebook, p.4.5-3, 1992). This definition differs from the business definition in that it stresses a systematic approach rather than "art and science". DODI 5000.2 adds that these actions are taken to bring risk "to an acceptable level in selected areas (e.g. cost, schedule, technical, producibility, etc.) and the total program (DODI 5000.2, p. 15-15, 1989). Risk management identifies and evaluates the vulnerable areas of a program. Its purpose is to provide a means of comparing risk management performance to a standard and tracking risk-related information.

3. The Defense Risk Management Process

A PM's risk management process sets objectives and repeatedly assesses the program for obstacles preventing those objectives from being attained. The DOD risk management process is similar to the basic process described earlier. It requires that criteria or a set of standards with which to judge successful risk assessment and mitigation be established early in the program's life. The DOD process consists of a different set of phases from the basic process. It consists of planning, assessing, analyzing, and handling risk (see Figure 2). This structure, like the basic approach, considers both internal and external circumstances affecting a program's objectives. It likewise allows the PM to formulate alternative courses of action and to make rational decisions on monitoring and controlling the outcomes of program events.

The four defense risk management process components are:

a. Risk Planning. This first phase defines the program's present and future risks. This establishes the need, purpose, and requirements for managing particular risks within a program to eliminate, minimize, or contain them. Risk identification in this phase gives a "plain English" description of risk events that can prevent program goals from being achieved. The program's Work Breakdown Structure is a favorite tool to provide a risk identification, rating, and analysis structure. Risk rating schemes include lessons learned, expert interviews, baselines, templates, analogy comparisons, program document evaluations, technology evaluations, and contractor risk evaluations. This phase corresponds with the business Risk Identification phase.

b. Risk Assessment. This is the examination of a program objective and assessment of those risk events posing potential problems. Risk ratings and a risk baseline similar to those described earlier give PMs a means of determining a

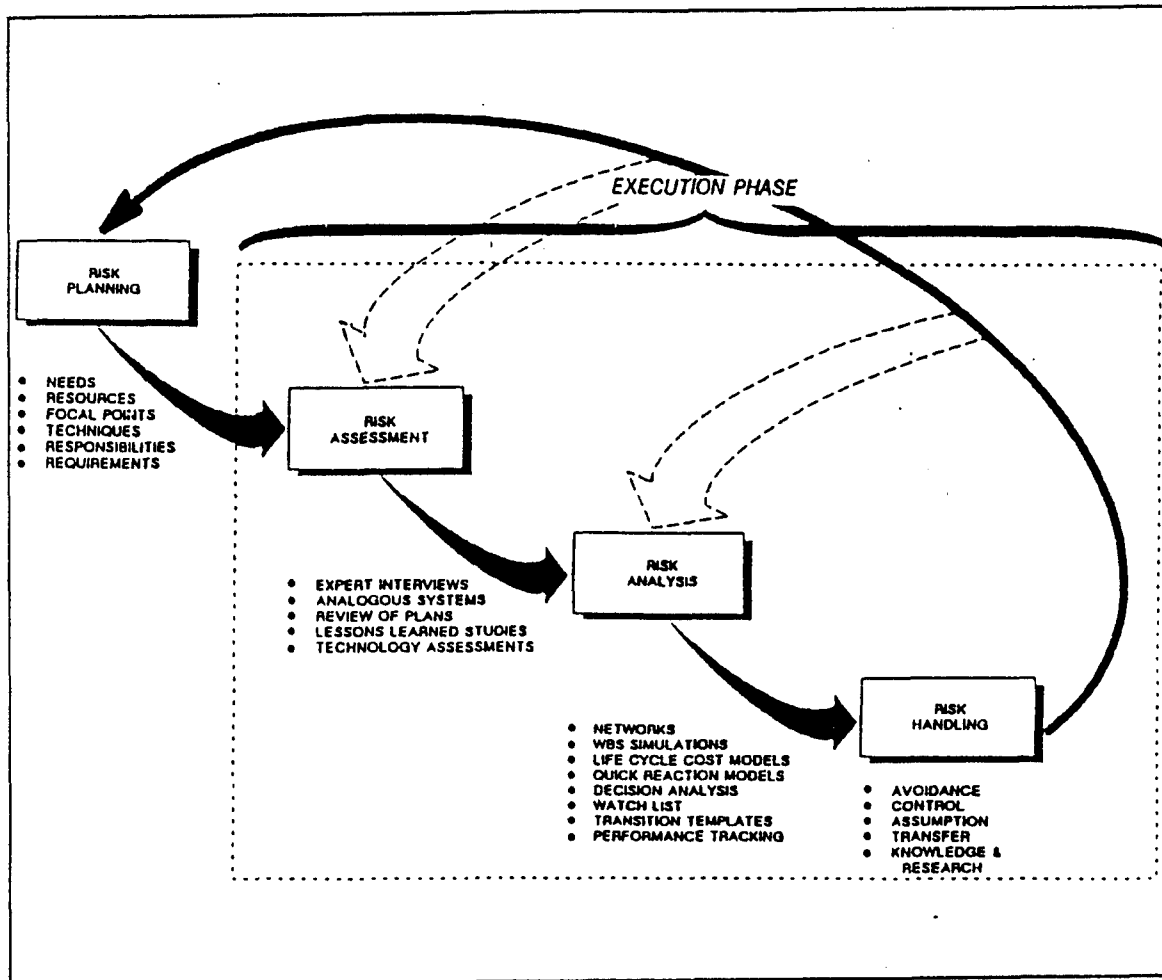


Figure 2 The DOD Risk Management Process (Source: DSMC Risk Management Concepts and Guidance, Chapter 5, 1989)

program's risk status. The combination of assessment and analysis shows points in a program where the consequences of risk are likely to occur, their severity, and what drives them. The DOD 4245.7-M risk templates are common DOD tools for assessing program risk. Risk quantification begins in this phase. Whereas business groups risk assessment and risk analysis together, the defense risk management process separates risk assessment and risk analysis.

c. Risk Analysis. Risk analysis is an examination of the changes in consequences caused by changes to risk input variables. Analytical and quantitative methods are used to

demonstrate the potential impacts of risk consequences on a program. These methods include simulations, network models (PERT, CPM), cumulative probability distributions, life cycle cost programs, and quick reaction modeling. These tools allow a PM to develop risk-handling options and techniques.

Risk analysis provides valuable outputs. One example of these is the watchlist (PM Notebook, p.4.5-4, 1992). A watchlist is a signalling mechanism for risk-based events or outcomes. The list consists of areas of risk, their expected impacts, and ways to detect and manage each prioritized risk area. It acts as a worksheet to track risk management progress and to show where the PM can make acceptable risk-program performance tradeoffs.

d. Risk-Handling. Handling risk areas completes the DOD version of the risk management process. This is the formulation of management options to control or minimize areas of risk. DOD risk-handling measures are categorized as avoidance, control and prevention, assumption of consequences, transfer of responsibility, and knowledge and research. Risk control processes are the most common risk-handling measures. They consist of event-based, Government reviews and audits paralleled by contractor systematic analyses, reviews, and tests. Such continuous monitoring and corrective actions must be coordinated and integrated into program plans and documents. This phase corresponds to the business phases of Risk Response and Risk Documentation.

The DOD risk management process is sequential and continuous much like the risk management process described earlier. Risk management evaluates what is achievable against what is planned; identifies risk areas using lessons learned, risk templates, work breakdown structures, and expert interviews; rates and quantifies risks; analyzes their severity of impact on program completion; and offers risk-handling options and tools. Once risk handling options are

implemented, the PM should document risk areas for future programs' benefit. A means of documenting the PM's risk management program is through the publication of a risk management plan.

F. DOD RISK MANAGEMENT POLICIES

Risk management policies for acquisition programs are described in the DOD 5000-series policies. The purpose of the 5000-series is to provide acquisition program policy, regulations, instructions, and format for PMS - to include their risk management programs. DOD Directive (DODD) 5000.1 is the first authority for risk management policy. According to DODD 5000.1:

Program risks and risk management plans shall be explicitly assessed at each milestone decision point prior to granting approval to the next acquisition phase. This includes: early identification of critical parameters, technology demonstrations to reduce risk, test and evaluation to determine system maturity and identify risks, contractor risk plans and trade-offs to keep risk at acceptable levels.

The Directive points out that risk assessment and reduction plans are required as part of the acquisition process to ensure sound program management decisions (DODD 5000.1, p. 1-5, 1991).

DODI 5000.2 follows DODD 5000.1 with more detailed guidance on managing risk. DODI 5000.2 Part 5B, published 1 February 1991 states:

A risk management program shall be established for each acquisition program to identify and control performance, cost, and schedule risks using the areas of risk identified in DOD 4245.7-M. The risk management program must include provisions for eliminating these risks or reducing them to acceptable levels. Industry participation in risk management is essential.

DOD 4245.7-M is a document containing risk management templates. These templates are tools for assessing and reducing program risks.

DODI 5000.2 elaborates on risk management in Part 5B, Change 1, dated 26 February 1993. It states "risks, risk reduction measures, rationale, and assumptions made in assigning risk ratings, and alternative acquisition strategies will be explicitly assessed at each milestone decision point."

Finally, the 5000.2-M reference for acquisition documentation and formats addresses the risk management area. DOD 5000.2-M indicates "The Integrated Program Summary (IPS) for each milestone, shall assess the risks with respect to the threat, technology, design, and engineering support, manufacturing, cost and schedule. The IPS shall summarize the actions being taken to mitigate those risks."

G. U.S. ARMY RISK MANAGEMENT POLICIES

U.S. Army leadership in and treatment of risk management in research, development, and acquisition programs began in 1970 (Muldrow, p. 28, 1985). In DA PAM 11-2, Research and Development Cost Guide for Army Material Systems (May 1976), paragraph 3.5, PMs are encouraged to manage risks by treating costs as ranges rather than point estimates. The Army Development Acquisition and Readiness Command (now known as the Army Material Command) Regulation, DARCOM-R 11-1 (April 1976) on systems analysis, focuses extensively on risk analysis guidelines. Appendix D of this DARCOM-R prescribes its Decision Risk Analysis Guidelines for PMs as follows:

1. a. Define the problem
- b. Establish the decisionmakers' preferences for trade-offs between cost, schedule, and/or performance
2. Establish the alternatives
3. Define the events
4. Collect the data

5. Determine the program risks
6. Select the best alternatives
7. Perform sensitivity analysis
8. Communicate the results

These steps are consistent with guidelines suggested in both the DSMC's risk management publication and the PMI body of knowledge.

H. SUMMARY

Through the DODD 5000.1 and DODI 5000.2, the Defense Department provides risk management material and guidance. The 5000-series was intended to communicate risk management policy and guidelines for all PMs.

The problem with DOD risk management policy is that policy and guidelines written for the Cold War defense environment was oriented toward full-scale, developmental programs and the five-phase acquisition cycle. NDI are the exception to these rules. Their risk management programs must be tailored because no explicit NDI risk management exists. The new dimension of risk management of NDI acquisitions, the DOD policies concerned, and the difficulties involved are the focus of the next chapter.

III. RISK MANAGEMENT IN NDI ACQUISITIONS

A. PURPOSE AND BACKGROUND

This chapter examines NDI acquisitions and the conditions that make NDI acquisition strategies attractive. It defines what NDIs are and are not, their advantages and disadvantages, and the acquisition policies governing them. This sets the stage to study how DOD risk management policies and practices address NDIs and support the PM managing a NDI acquisition program.

Commercial business and DOD have new roles and face new trends compared to those of the Cold War status quo. During the Cold War, the defense establishment drove the pace of technological innovation. Several trends have since shaped new roles (Borrus, p.41, 1990). First, civilian technology no longer trails military technology as it did for several decades during the Cold War era. Next, commercial production features greater quality and efficiencies in flexible manufacturing, multiple product lines, just-in-time inventories, and lower volume production runs. Finally, many critical defense technologies have considerable overlap with commercial technologies.³ The need to modernize and retain state-of-the-art capabilities for military forces in an era of capped military spending supports the purchase of commercial products for military use. The primary means of acquiring and fielding these products is with NDIs.

B. THE DEFINITION OF NDI

The basic definition of NDI is "a broad term covering material available from a variety of sources, with little or no development effort required by the government" (DSMC NDI

³ The material in this chapter references the DSMC NDI Acquisition Guide, p.xiii to p.78, 1992 except as indicated.

Acquisition Guide, p. 3, 1992). NDIs are an option for fielding systems more quickly and cheaply than with a new, developmental item. NDI acquisition strategies look to commercial vendors and federal, state, local, and foreign governments as sources for the desired item. They also consider any commercial item in design, development, and/or production but not yet available for commercial use (Prueitt, 1994).

The U.S. Congress defines a NDI as:

1. Any item available in the commercial marketplace.
2. Any previously developed item in use by the U.S. Government or cooperating foreign governments.
3. Any item of supply needing only minor modifications to meet DOD requirements.

The military services define NDIs more specifically. The Army version distinguishes NDI in three categories (Quindlen, p. 53, 1989):

1. Category A (Basic NDI): Off-the-shelf items to be used in the same environment for which items were designed with little or no development or modification required.
2. Category B (NDI Adaptation): Off-the-shelf items to be used in an environment different than that for which the items were designed with some development required. These include products requiring hardening, strengthening and/or related modifications. This category is sometimes referred to as "Ruggedized NDI".
3. Category C (NDI Integration): Integration of existing componentry and the essential engineering effort to accomplish systems integration with research and

development to integrate systems. This category is sometimes labelled "Militarized NDI".

Confusion sometimes arises in distinguishing a NDI from a commercial-off-the-shelf (COTS) item. A COTS item makes up only a portion of DOD-classified NDIs. COTS items are commercial hardware/software items not modified by the government, items that are in the commercial inventory or production, that have proved their performance in a similar environment, that have an existing support structure, have an internal support structure, have an internal configuration that flows with commercial changes and generally are integrated with other hardware/software items to become part of a system or subsystem capability.

C. USING NDI FOR REDUCING PROGRAM RISKS

NDIs have become increasingly important in equipping our services. NDI acquisitions are more prevalent as an alternative to costly, lengthy, and more risky developmental programs. The lower risks commonly associated with cost, schedule, and technical performance make NDI acquisitions politically and programmatically popular.

NDIs are considered a means of mitigating program risks. Risk mitigation involves the assessment and response activities of risk management which were outlined in the previous chapter. Risk mitigation is implemented through the shortened or eliminated Demonstration and Validation (DEMVAL) Phase and Engineering and Manufacturing Development (EMD) Phase of the NDI acquisition cycle. The streamlined NDI acquisition cycle reduces cost and schedule risks. However, NDI acquisitions do not eliminate risk but may in fact introduce new, significant risks. These risks will be examined shortly.

An effective NDI acquisition program must fulfill the Service's needs by fielding mature technology that preserves

combat readiness while satisfying popular expectations. The three features which attract substantial DOD and Congressional popular support to NDI alternatives but which challenge the PM are:

1. Meeting user requirements based on available commercial market solutions.

2. Tailoring user requirements to suit NDI acquisition strategies while avoiding "goldplating".

3. Opening up greater access to state-of-the-art technology for DOD while keeping pace with changing threats, emerging technologies, and innovative combat systems.

To DOD and Congressional decisionmakers, NDIs appear to be a low-risk approach for meeting the Services' needs and requirements. The danger, however, is in forcing NDI solutions on PMs and their customers (the user community), when those NDI neither meet requirements nor transition effectively from commercial to battlefield environments.

D. NDI BENEFITS AND POTENTIAL RISKS

1. Benefits

NDI acquisitions have many benefits which make the transition of commercial technology to military use a popular course of action. A NDI acquisition provides an existing or modified system to meet a stated requirement in a cost-effective and timely manner. The benefits NDIs offer are:

a. Time

Decreased acquisition cycles, shorter procurement lead times, and reduced testing requirements often result in quicker system delivery and fielding (Cain, p. 22, 1993). See Figure 3.

b. Cost

Minimized research and development costs reduce expected lifecycle costs. These costs savings stem from using commercial specifications and the competitive pricing inherent in commercial markets (Cain, p. 23, 1993)

c. Technical Performance

State-of-the-art technology from the commercial marketplace meets operational requirements with limited design and development. NDI programs introduce the acquisition of mature technologies, with validated and established production techniques, and high quality standards. Reliability, availability, and maintainability (RAM), and supportability data are already established as part of commercial testing and market demands (Garcia, p. 8, 1991).

d. Risk Reduction

Risks to development costs, program duration, and leading edge technical performance are decreased. NDI limits risks with an established cost structure, minimized production start-up costs with currently operating production lines, economies of scale where the Government is not the sole customer, and the competitive pressures of commercial markets on reasonably-priced, high volume production (Vandeviere, p. 13, 1994).

e. Contracting

Simplified contracts often result from procurement of established products. The increased use of Fixed-Price-type contracts puts more risk responsibility on the

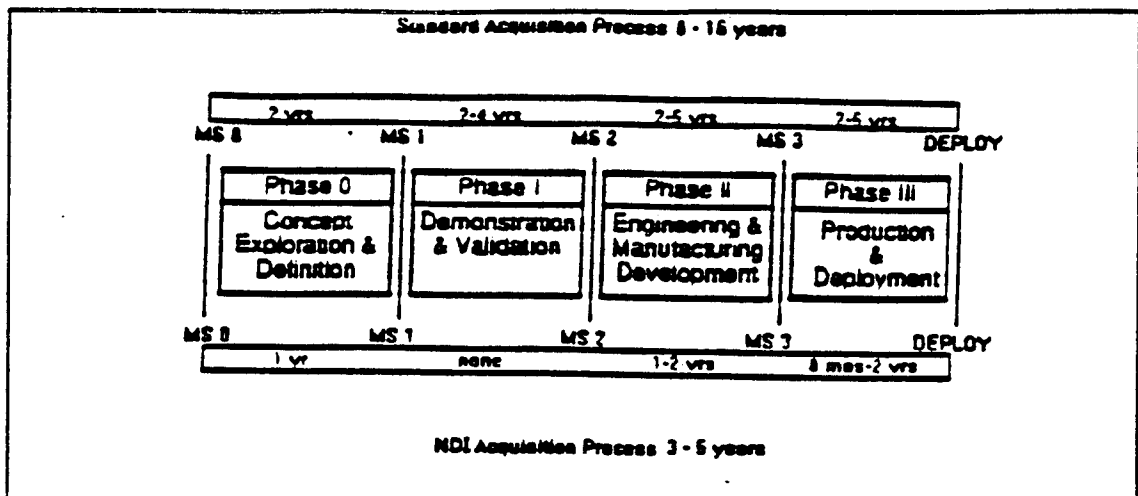


Figure 3 Notional Developmental and Non-developmental Item Timelines (Source: Vandeviere, Chapter 2, 1994)

contractors' shoulders while reducing Government risk (GAO, p. 11, 1989).

2. Potential Risks

A developmental item PM traditionally faces cost, schedule, performance, supportability, and programmatic risks whereas the NDI PM's program risks are more unique. NDIs typically reduce cost and schedule risks. The risks described below affect the technical performance, supportability, and programmatic objectives in a NDI program. In reviewing the literature, the author has determined that the following five areas are the most pressing potential risks facing NDI acquisition programs: Requirements, NDI Acquisition Management Environment, Specifications and Standards, Test and Evaluation, and Integrated Logistics Support. If not properly addressed, these risks may easily affect cost and schedule objectives as well.

a. Requirements

"Initial (Operational) Requirements Documents (ORD) are developed without careful consideration of what is currently available as NDI" (DSMC NDI Acquisition Guide, p. 14, 1992). Requirements risks surface when the operational community develops an ORD focused entirely on operational need, independent of market solutions available to meet those needs. NDI requirements risk can arise from users developing an ORD based on available commercial **technology** rather than available commercial **products**. The user proceeds to mix and match the desired functions or capabilities of several products into one ORD when no existing item can meet user requirements without making extensive modifications. On the other hand, the user may accept an available NDI solution which does not strictly comply with all the specified requirements.

Requirements risk affects all of a program's objectives. This risk in NDI acquisitions often indicates a lack of flexibility in ORD development. The risk grows when the requirements generation process does not include the PM. The PM's responsibility, as the material developer, is to respond to user needs but to be fully conscious of technical risks, affordability constraints, and schedule impacts. The user's responsibility is to be realistic in stated requirements, weigh proven capability and rapid deployment benefits against performance limitations, and negotiate acceptable trade-offs with the PM. Too often these responsibilities are not integrated or communicated. Requirements risk affects a user's desire or ability to back off of validated ORD requirements. When minor modifications are pursued to comply with stated requirements, the NDI may take on extensive and costly developmental item characteristics and defeat the purpose of the NDI acquisition

strategy (Cain, p.24, 1993).

Insufficient or ineffective market analysis accentuates the problem. Market analysis may not be detailed enough to identify technologies and potential contractors. The user/PM team then cannot evaluate the strengths of a NDI acquisition strategy compared to a developmental one. Market analysis, when properly used, contains both broadly-scoped market surveillance to canvas technologies and product developments and the narrower-focused market investigation used to determine what technology or products meet user needs. Insufficient commitment of effort and resources to teaming and market analysis leads the user and PM to either neglect potential alternatives or falsely conclude that no commercial alternative exists to fulfill user requirements.

b. NDI Acquisition Management Environment

The NDI acquisition management environment confronts the PM with the complexities of multiple stakeholders (DOD, Congress, the Service, and the user), internal and external perceptions and attitudes (cultural resistance) towards NDIs, commercial standards and practices, developmentally-based paperwork requirements, audits, and inspections, and mistrust among the NDI acquisition participants. These elements create programmatic risks for the PM.

The successful achievement of cost, schedule, performance, and supportability objectives depends on the PM's interaction and effective teaming with the prime contractor as well as with the user community. Trade-offs between ORD-based requirements and cost and schedule constraints on the program may become sources of conflict. The Government's desire to buy as opposed to the contractor's unwillingness to provide adequate technical data may become a major source of friction. The contractor's unwillingness to allow quality control

oversight and qualification of its manufacturing and production processes may contribute to a contentious relationship with the PM and the Government. NDI performance expectations may not be realistic to both parties. Lack of communication before and after program reviews may prevent clearly-defined agreements and changes from being implemented during the NDI acquisition cycle. With the shortened NDI acquisition cycles, the communication and feedback loops may not develop and mature. The results may become mistrust and inappropriate trade-off decisions.

NDI acquisition success requires changing traditional, sometimes antagonistic procurement mindsets in the acquisition and user communities. The NDI environment may not be conducive to effective communication, coordination, and cooperation. The willingness to objectively assess and choose between the best technology available and a full-scale development start-up requires open-minded acquisition team members. The team members' responsiveness to new acquisition strategies requires overcoming ingrained developmental program biases. Such an atmosphere may require extensive training and education (Garcia, p. 26, 1991).

Political and defense interests may drive an acquisition towards a NDI acquisition strategy when it is not appropriate. This confines the PM's efforts to the "NDI box (with) NDI boundaries and NDI criteria" when that NDI option may not meet the user's requirements. The appeal of NDIs may foster "zero defects" expectations whereby few, if any, program or contractual problems will be accepted, especially if the user has experienced previous acquisition program failures. Given constrained budget and resource environments, programming and budgeting decisions from outside the PM's sphere of influence may create programmatic risks themselves.

Lastly, NDI streamlining may ignore useful development program management tools such as program reviews and design

reviews. These tools may be ignored to meet accelerated schedules and to minimize or streamline the commitment of resources, funds, and personnel.

c. Specifications and Standards

Specifications and standards serve as a means of requirements verification in a product's design and development but they contribute to technical performance risks in a program. The risk in specifications and standards (S&S) concerns the use of military as opposed to commercial S&S.

Military specifications (MILSPECS) and military standards (MILSTDS) draw criticism from industry as being excessively demanding, outdated, incompatible with NDIs, and unnecessary in light of the detail presently existing in commercial item descriptions (CIDs). In some cases such as nuclear delivery systems, strict MILSPECS and MILSTDS are justifiable, but the tendency is to go beyond performance (form, fit, and function) requirements to describe the design and manufacturing processes themselves. The S&S risks materialize in contract prices, timeliness, access, and manufacturing efficiency, all of which may be lost to the contractor and the user if MILSPECS and MILSTDS are required in product design, development, and manufacturing.

The challenge for NDI PMs is to leave the safety and security of MILSPECS and MILSTDS and to use CIDs and commercial standards. A NDI acquisition strategy encourages acquisition agencies to break inclinations to "cling to the security of MILSPECS and MILSTDS" and instead to take advantage of commercial technology development, innovation, and streamlining initiatives. The PM's risk is one of accepting and using unfamiliar commercial design and development parameters. With commercial S&S come assumptions about the conditions and tasks under which the product must perform as well as the intended purpose of the standard. The

S&S may be unique to a particular company, product, or process and not easily transferrable.

The specifications and standards risks consist of either choking the NDI process with required MILSPECS or relying on CIDs for products, parts, and spares which may or may not match MILSPEC and MILSTD detail. The implicit understanding of combat environments and conditions may also be lost. The grasp of military operational conditions in commercially-oriented S&S may be foregone. Competitive reprocurments that depend on CIDs as technical data package references may jeopardize functional and technical performance in the field. This in turn depends on the PM being equipped with a detailed market analysis that examines the suitability of CIDs to meet user and system requirements.

A shrinking DTIB is one trend DOD witnessed after winning the Cold War. Stemming this trend is potential dual-use (military and civilian) item applications. Defense-commercial product usage enables more flexibility in procurements, closes the gap between military and commercial products, and keeps the DTIB competitive in the global marketplace (Gansler, p. 115, 1993). Yet the defense industry, like the acquisition workforce, is resistant to these opportunities (Mandel, p. 193, 1994). Dual-use and commercial specifications in this post-Cold War era are becoming more suitable for meeting the level of detail required for military requirements. But despite their political popularity, commercial market practices, specifications, and production standards continue to be a hard sell (Schrage, p. B3, 1994).

d. Test and Evaluation

Test and evaluation (T&E) programs for NDIs must achieve the same purpose as developmental T&E programs: to define risks. This risk functions to consider how a system meets its functional specifications in the intended operational environment. The T&E risks in NDI acquisitions are: testing away NDI time and cost savings for the sake of testing and risk elimination; incomplete or inadequate design, development, production, and logistics support T&E by both the contractor and PM due to the pressures of an accelerated acquisition (Cain, p. 24, 1993); or assuming the contractor's T&E results are sufficient and merely conducting technical reviews of T&E data (Garcia, p. 20, 1991). Ineffective verification of compliance with requirements and specifications may result. For example, prototypes may be proposed as competitive designs without sufficient production and support facilities and activities. PMs who implement streamlined NDI T&E programs and use T&E data reviews in place of production and support capability evaluations (or at least demonstrations) may be creating risks in their programs. NDI T&E risks therefore, can contribute to technical performance and supportability risk in the program.

NDI T&E programs are a form of risk management, not risk elimination, used to prove technical capabilities, operational effectiveness, and suitability. The T&E community sees four areas of risk in NDI system testing:

1. Requirements may not be clearly understood.
2. Definition of the operational environment may not be clear and thus can't be tested with a level of confidence.

3. Definition of system interfaces and operability between the NDI system and others it must interface/operate with may not be clear.
4. Test documentation and support issues may not be addressed in the test program.

Two impediments in the T&E community also exist:

1. The T&E "mindset". The testers orient on traditional developmental approaches and ignore non-traditional, NDI T&E approaches tailored to a streamlined acquisition strategy. This non-traditional approach may require different T&E methods, timelines, and levels of detail.
2. Lack of knowledge and experience with commercial test practices and standards.

A streamlined NDI T&E program may introduce risks of insufficient source evaluation, inadequate competition, and incomplete market analysis. This may lead the PM to overlook promising alternatives.

e. Integrated Logistics Support

"ILS in an NDI acquisition can be more difficult because of the difference in an acquisition process" (DSMC NDI Acquisition Guide, p. 41, 1992). NDI integrated logistics support (ILS) activities performed in DEMVAL and EMD are often accelerated to ensure support arrives concurrently with the item. ILS risks involve events that disrupt maintenance planning, manpower, supply support, support equipment, technical data, training and training support, mission critical computer requirements, packaging/handling/storage/transportation, facilities, and design interface of operational capability with resources. The ILS issue becomes

one of identifying what trade-offs, logistics-related requirements, and departures from developmental ILS are necessary.

A NDI acquisition strategy creates several ILS risks. While real reliability and training data may be in place, reduced lead time means less ILS planning time and time to develop organic support. The ILS risk of proliferating hardware and software changes (e.g. when DOD is unable to buy the technical data rights for maintaining configuration control of commercial items) can be significant. ILS risks can contribute tremendous complications to NDI acquisition planning and execution.

A PM develops an ILS plan (ILSP) in conjunction with the NDI acquisition strategy. This outlines risk management measures for supportability risks specified in the ILSP. A NDI program's supportability objectives act as part of functional requirements. Supportability risks may appear in design by overlooking realistic operational conditions, RAM, survivability, and test equipment required. NDI supportability plans may not be included in Government requests for contractor proposals (RFPs), bidding contractors' responses, and as NDI source selection criteria. ILS risks in NDI competitive proposals may include neglect of warranties, data rights, and best value procurements.

The type and level of support affects the severity of impacts ILS risks have in an NDI acquisition. The user and PM may not clearly decide whether to use organic support, contractor support, or a mix of both in the ILSP as interim and longterm measures. Trade-offs may not be included in this decision. The decision should be incorporated into the overall acquisition strategy. Decisions on the level of repair affects spares and repair parts requirements. The sources of supply are also at issue.

The rapid availability of NDIs might outpace their

logistics support structure in the field. An accelerated acquisition cycle may overpower training, maintenance, and logistics support activities for a new item. The NDI product may lack sufficient detail and realism in commercial training support, training equipment and documentation. Test and evaluation data on design, performance, and logistics support may not be complete or available. Supply items may lack the necessary lead time to support fielding and new equipment training. Reduced commonality and standardization accompanied by increased manpower and support requirements may actually add costs over the product's lifecycle (Vandeviere, p.15, 1994). Configuration control may be complicated by rapid obsolescence (Cain, p.24, 1993). This then jeopardizes component integration and interoperability as components and parts are repeatedly being replaced. The supplier may cease production of the item which creates a problem for spares availability and proliferation of models. This reduces material readiness by creating incompatibility of system components. The item may require contractor maintenance support in an operational environment.

To summarize, NDI requirements, acquisition management environment, S&S, T&E, and ILS risk issues will challenge users, PMs, and potential contractors. The challenge will be to balance benefits in NDI acquisition costs and schedules with technical performance, programmatic, and supportability risks. Common threads tying NDI program objectives and risks together will be teaming among the acquisition community members, addressing traditional biases, market analysis, the clarity and stability of user requirements, and the ability of the PM to cope with the accelerated features of a NDI acquisition strategy.

E. NDI ACQUISITION POLICY

The risk management portions of DOD and U.S. Army acquisition policy and instruction are thorough. The NDI sections are treated likewise.

1. DOD DIRECTIVE 5000.1

DODD 5000.1 "requires the use of an existing U.S. or allied military or commercial system be assessed and thoroughly reviewed as an approach to satisfy a need or requirement. The directive also states that when tailoring an acquisition strategy to meet individual circumstances, consideration should be given, whenever possible and appropriate to maximizing practical use of commercial "off-the-shelf" (COTS) products" (PM Notebook, p.1.5.1-1, 1992).

2. Government Policy

The National Defense Authorization Act of 1987 "requires DOD to use NDI to fulfill needs to greatest extent possible. It also requires that DOD state its need in terms of functions to be performed, performance required, or essential characteristics" (PM Notebook, p.1.5.1-1, 1992). This bill followed the 1986 Packard Commission's report which proposed that (President's Blue Ribbon Commission on Defense Management, 1986):

DOD should make greater use of components, systems, and services available off-the-shelf. It should develop new or custom-made items only when it has been clearly established that those readily available are clearly inadequate to meet military requirements.

The commission's recommendation to the Under Secretary of Defense for Acquisition was to require PMS "to receive a waiver before using a product made to military specifications if there is an available commercial counterpart".

F. IMPLICATIONS OF RISK MANAGEMENT POLICY FOR NDI ACQUISITION PROGRAMS

The paths of risk management policy and NDI policy do not cross. DOD policy emphasizes both risk management and NDI but in differing directions. Risk management policy in the 5000.-series keys on developmental items and acquisition strategies. NDI policy focuses on its risk mitigation features gained through use of established commercial alternatives. Cost and schedule benefits aside, no description or instruction for risk management in an NDI program appears in the 5000.-series. Risk, risk management, and NDI subject area searches using the Air Force Acquisition Model (AFAM) supplement 1.4 dated 1 December 1993 revealed no matches between the three subjects.

This policy void exists within the expectation that the PM will "tailor" the risk management approach to NDI much like the acquisition cycle is tailored to NDI. Tailoring is accepted as overlapping, combining, or omitting elements of the acquisition process (DODI 5000.2, p.2-6, 1994). A NDI acquisition strategy is a tailored version of the developmental acquisition process according to the type of program, program risks, user requirements, and needs. Tailoring NDI acquisitions according to program risks, however, is not accompanied by risk management guidance or instructions in either DODD 5000.1 or DODI 5000.2.

NDI cost, schedule, performance, supportability, and programmatic objectives entail certain opportunities and risks. Today, these risks must be managed without official

guidelines because DOD and the Army, though quick to embrace NDI benefits, have not followed their enthusiasm with updated policy. Dual-use technologies, NDIs, and COTS items are popular, in fact mandated, as the first alternative for filling user requirements. Policy is needed that recognizes the increased use of commercial technologies for military applications and their corresponding risks.

The risks in NDI acquisition are not as widely described or documented as the benefits. The absence of documentation and description is due to lack of familiarity with the NDI acquisition risks in competitive, commercial (defense and non-defense related) industries by PMs, users, and DOD policy writers. These commercial market industries provide DOD with a growing number of NDI systems not initially developed to meet a military need. The acquisition community's lack of familiarity means a lack of comfort or confidence in commercial practices and standards. This then creates mistrust and inhibits defense-commercial interaction. Without formal risk management policy and guideline initiatives by DOD acquisition participants, definitive policy and instruction has insufficient support or momentum to be officially implemented.

In NDI programs, probabilities of adverse events and their consequences in requirements, the acquisition management environment, S&S, T&E, and ILS significantly impact the achievement of program objectives. **PMs need more explicit guidance in policy and instruction regarding NDI risk management in the streamlined, accelerated NDI environment.**

1. NDI Requirements. Policy does not address how requirements generation and formulation during the NDI Concept Exploration and Definition phase creates risk and how it should be managed. Requirements and expected capabilities are not compared to what is realistic and commercially available. Market analysis, investigation, and surveillance are not

adequately considered as part of the risk management process.

2. Acquisition Management in the NDI Environment. The claim "this is the way it's always done" captures the typical resistance inherent in the developmental perspective often used by PMs, users, and DTIB contractors. Risk management policy describes none of the interrelationships between the acquisition environment and its participants: PM, user, DOD, commercial vendors of NDIs, and Congress. Constrained resources, competitive pressures, extensive oversight, and constant change create continuous friction. These frictions can make it difficult for DOD's PMs, users and commercial representatives to work together effectively toward evaluating trade-offs and satisfying user needs. The milestone reviews and in-progress reviews of a NDI program lack risk management guidelines for examining risk management effectiveness. Measures of effectiveness and measures of performance are absent for NDI risk management.

3. NDI Specifications and Standards. CIDs are unfamiliar ground to much of the acquisition workforce. MILSPECS and MILSTDS provide a "comfort level" to PMs telling the contractor specifically what to do and how to do it. Managing risks inherent in the use of CIDs as opposed to MILSPECS and MILSTDS is an unknown because extensive consultation with DTIB manufacturers on technical performance is relatively new. Existing risk management policy does not accommodate well the loud voice that the DTIB must have in establishing performance S&S for NDI items. To the contrary, under existing policies, DOD and its PMs have grown accustomed to being the dominant voice in such matters.

4. NDI Test and Evaluation. T&E is a part of risk management, specifically risk assessment and analysis. Risk management for NDI T&E risks overlaps with requirements, the NDI acquisition environment, and specifications risks. DOD policy does not spell out guidelines for managing risks in NDI

testing methodology, scheduling, or integration with other systems in operational environments.

5. NDI Integrated Logistics Support Planning. The greatest number of risks in fielding NDI involve supportability. Risk management policy neglects the market analysis of modification requirements, sustainment of logistics and supply, and availability of the product and its production operations over the typical 15-20 year defense horizon. DOD policy overlooks risks in contractor versus Army-run depots, buying upgrade/pre-planned product improvement (P³I) packages, spares, and technical data packages. The "other sources of challenges are the standard internal DOD processes which must be expedited or tailored to accommodate an NDI strategy" (Vandeviere, p.15, 1994). This policy gap must deal with such issues as training development, logistics and maintenance support, personnel management systems, and military force structure planning.

G. SUMMARY

DOD and U.S. Army risk management policy provide no explicit details or guidance on managing NDI-related risks. DOD's shortfalls were described above. Similarly, the Army has not addressed the growing NDI area with risk management guidelines with which a PM could structure an NDI risk management program. With the increasing level of commercial products in DOD and U.S. Army inventories, it behooves them to initiate policy and guidelines for NDI risk management programs.

The following chapter studies the efforts of the Army's FAAD Sensors Program Office to manage the risks in its NDI acquisitions and assemble a risk management program in the absence of NDI risk management policy.

IV. THE FAAD SENSORS CASE

A. PURPOSE

The purpose of this chapter is to examine the risk management program of an Air Defense Artillery NDI acquisition program office. The chapter begins with a review of the ADA's critical early warning radar need upon retirement of the Forward Area Alerting Radar (FAAR). The review briefly describes air defense doctrine and early warning radar requirements. The chapter then introduces the Forward Area Air Defense (FAAD) Sensors program which includes the FAAR's NDI replacements, the Ground Based Sensor (GBS) and the Light and Special Division Interim Sensor (LSDIS). It explores the risks facing the two systems. The chapter summarizes the PM's overall risk management program and risk management plan. The chapter considers how the programs' risks and risk management may have resulted in the delays in fielding early warning radars and the consequent ADA force readiness gap. The chapter concludes with a look at the support provided by DOD risk management policy to NDI system PMs as they structure their risk management programs.

B. EARLY WARNING OVERVIEW AND FAAD ACQUISITION IMPLICATIONS

1. The FAAR and FAAD Doctrine

Early warning networks (EWN) support battlefield command, control, communications, and intelligence decisions for FAAD battalion commanders and Army division commanders. Early warning radars making up the EWN provide continuous surveillance, detection, acquisition, and tracking information on potential air threats flying over an Army division's area of operation. Ideally, the radars operate both day and night, in all weather conditions, in both electronic countermeasures (ECM) and anti-radiation missile (ARM) environments (GBS

Acquisition Plan, p.8, 1990).

Until 1990, the Army's ADA branch relied on the AN/MPQ-54 FAAR to provide its critical early warning information. The FAAR early warning system consisted of an early warning van with a telescoping radar pulled by its prime mover, the Gamma Goat. Air intelligence preparation of the battlefield (IPB) and proactive air defense coverage depended on the FAAR to continuously broadcast early warning of approaching threat, unknown, and friendly aircraft. Without inherent early warning capabilities in ADA battalions, the battalions' IPB processes and fire units' combat effectiveness suffer. The result of this lower effectiveness is a higher attrition rate of prioritized divisional assets by enemy air threats as well as increased incidents of fratricide.

The Army removed the FAAR from active service as of 31 October 1990 (LSDIS Acquisition Plan, p. 7, 1990). The FAAR was scrapped because it proved highly susceptible to ECM, suffered from a poor operational readiness rate, and did not cue ADA fire units effectively to approaching enemy aircraft (Stolt, June 1994). The FAAR's Gamma Goat prime mover experienced consistent maneuverability limitations. The radar's range limitations impaired its survivability (in the face of ARM). The FAAR system had incompatible communications configurations for digital radio transmissions and its design featured no air-droppable capability (Wilson, August 1994).

No field-ready early warning replacement systems existed for Desert Shield and Desert Storm. Divisional ADA battalions deploying to the Persian Gulf either removed their FAARs from "mothballs" for minimal early warning capability or deployed without them. By the conclusion of the campaign, divisional ADA units would be relying on "1940's Eyeball Technology", commonly called binoculars, as their organic EWN capability (Tremmel, 1994).

Replacing binoculars with effective early warning radar technology has become an urgent requirement for the ADA branch and the Army (FAAD Sensors PMO, 1994). ADA FAAD doctrine depends on an effective early warning component to succeed. FAAD doctrine integrates command and control nodes, fire units such as Avenger teams and Bradley Stinger Fighting Vehicle, and early warning radars to provide comprehensive FAAD protection to forward deployed Army divisions. DOD and the Army tolerate this EWN readiness gap while replacement radars are tested and produced (Tremmel, 1994). The readiness gap left by the retirement of the FAAR mandated an effective defense acquisition program to fill the early warning need and make FAAD doctrine viable (Tremmel, 1994).

2. Acquisition Implications

Past FAAD acquisition program difficulties and the FAAR's problems have created an environment of high risk for future programs and close DOD scrutiny for ADA branch PMs. FAAD acquisition programs suffered a string of disappointments in the 1980's and early 1990's. The Divisional Air Defense Gun (the Sergeant York), the Roland, the Air Defense Anti-Tank System, and the Fibre-Optic Guided Missile were all FAAD-related programs that were cancelled due to inadequate technical performance or high design and development costs.

The FAAD programs' reputation for expensive failures combined with the FAAR's lifecycle maintenance and supportability woes increases the danger of performance, programmatic, and supportability risks. Any future ADA acquisition to support FAAD, whether a weapon system or radar, would also require close management of its cost and schedule risks. This environment would dictate more substantial and detailed FAAD Sensors program risk management.

A lower-risk acquisition of EWN systems requires that the PM recognize the Desert Storm's legacy. This legacy consists of the expectations by DOD, Army, and Congressional policymakers that the U.S. Air Force (as it did in the Gulf War) will always maintain air superiority in any conflict. The consequence of this assumption is that approval of major defense acquisition programs and resource decisions would neglect or discount air defense early warning as a justifiable need that required and deserved funding. Given past FAAD acquisition failures, their inadequate risk management efforts, and arguments against the need for Army EWN, close risk management is needed to prevent loss of program support and to control possible environmental (political) risks.

This set of circumstances demanded that a successful EWN acquisition program had to field long-term, operationally effective, and suitable systems while effectively managing risk. A streamlined and tailored NDI system acquisition which met operational requirements and featured limited program risks would be ideal for the situation.

C. THE GROUND BASED SENSOR (GBS)

1. GBS System Overview

The FAAD Sensors PM manages the GBS as one of two systems acquired to provide ADA its EWN capabilities. The AN/MPQ-64 GBS is a three-dimensional battlefield air defense radar which employs a modern, phased array antenna for azimuth, elevation, and range data for approaching air threats. It automatically detects, tracks, identifies, and reports targets. It tracks rotary and fixed-wing aircraft, unmanned aerial vehicles (UAVs), and cruise missiles. It classifies targets as fixed-wing or rotary aircraft and differentiates air targets from

ground targets. It provides cueing data and track updates once every two seconds using digital communications to fire units. Its 40km range allows it to facilitate target acquisition beyond ordnance release lines to maximize fire unit reaction time and engagement ranges. Its Identification Friend or Foe (IFF) feature prevents fratricide by interrogating aircraft in terms of their coded identity. It tracks and searches for targets simultaneously (GBS Integrated Program Summary (IPS), p. G-1, 1994).

The GBS is a NDI system. It is the AN/TPQ-36A Firefinder radar modified for FAAD missions and requirements (see Figure 4). It is manufactured by Hughes Aircraft Corporation. The GBS features a proven system capability with extensive data and support information concerning cost, schedule, performance, and supportability program objectives.

2. The GBS Acquisition Strategy

The GBS mission need studies began in 1979 as part of an automation-based, ADA force modernization initiative. FAAD doctrine and a GBS acquisition strategy evolved from these studies. The acquisition strategy emphasizes systems near or ready for production. The requirement for a FAAR replacement was approved by the Vice Chief of Staff, Army on 3 September 1985. The requirement established that fielding begin in Fiscal Year 1991 employing an NDI sensor and common Army hardware and software. The Milestone III Acquisition Decision Memorandum approved the GBS NDI Acquisition Strategy on 19 August 1986 (GBS IPS, p. C-1, 1994).

The FAAD GBS Request for Proposal (RFP) was issued on 19 April 1988. Hughes was the only respondent. Candidate evaluation tests proved its proposed AN/TPQ-36A radar did not meet requirements. The solicitation was terminated on the basis of unattainable performance requirements contained in

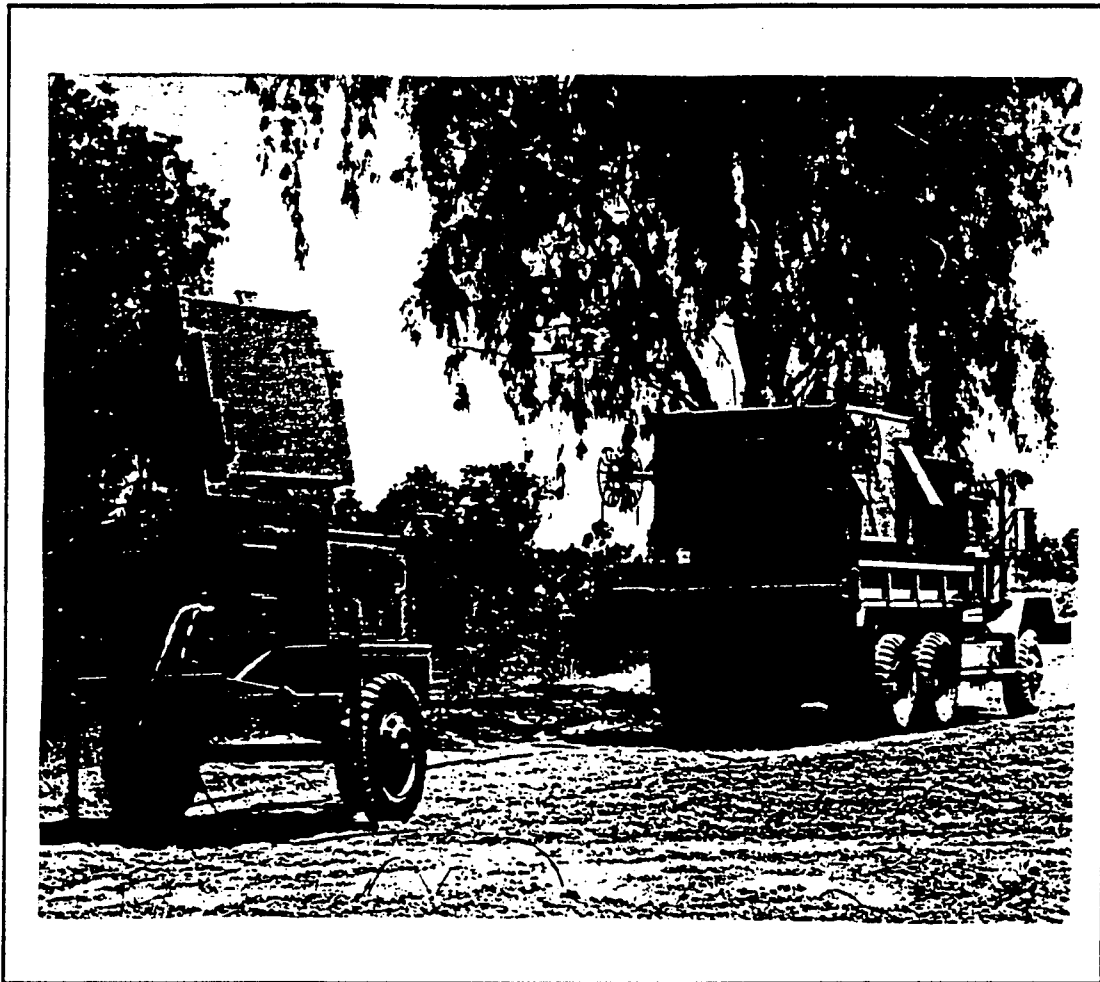


Figure 4 The Ground Based Sensor (Source: FAAD Sensors PMO, 1994)

the ORD. Minimum operational requirements were reassessed, the GBS ORD was amended, and the new ORD approved by the Army on 29 November 1989.

With relaxed requirements, the Army issued a competitive resolicitation for GBS development contract bidders which included a Source Selection Evaluation Test (SSET). The SSET consisted of proposal evaluations and field tests focusing on both technical and operational requirements. The proposal emphasized that the Government desired the "best value" GBS

system to satisfy its requirements (GBS IPS, p. C-2, 1994)⁴.

Seven candidates responded to the new SSET contract solicitation. The goal was a NDI sensor with reduced Government development costs and a shorter development phase. Hughes won the competitive evaluation and was announced as the contract awardee in December 1991.

GBS development began on February 1992. Pre-production sensors were delivered and pre-production qualification tests (PQTs) were successfully completed as part of the program's Phase I. The initial sensors met performance and operational requirements in accordance with exit criteria. Phase II testing, which concerns the integration of GBS with FAAD command, control and intelligence (FAADC³I) systems, Avenger, and Man Portable Air Defense Stinger (MANPADS) teams will continue until pre-production sensors are completed and delivered in February 1996. GBS fielding will finally begin in 1997 (GBS IPS, p. C-4, 1994).

D. THE LIGHT AND SPECIAL DIVISION INTERIM SENSOR (LSDIS)

1. LSDIS System Overview

The FAAD Sensors PM manages the LSDIS as the second of the two systems being acquired for FAAD EWN capabilities. Whereas the GBS is initially designated for ADA units supporting armored, mechanized, and armored cavalry divisions,

⁴ Note: Best value is defined as "acquiring a production ready system through full and open competition that best meets the Army's needs considering cost, schedule, performance and risks" (LSDIS Acquisition Plan (AP), p. 8, 1990). The best value approach strives to meet Army needs by the product itself or with a P3I program. It differentiates minimum requirements from objective requirements. The contractor can meet minimum requirements rather than objective ones. The disadvantage is that the Government is not assured of ever reaching those objective requirements.

the LSDIS is dedicated primarily to ADA battalions in light infantry, airborne, and air assault divisions and contingency corps. The LSDIS is a two-dimensional air defense radar that alerts fire units with azimuth and range data on approaching short-range, low-altitude aircraft. It is a highly mobile, lightweight, manportable system which detects and automatically classifies fixed-wing and rotary aircraft up to a range of 20km (see Figure 5). It is an interim system until a light-weight version of the GBS is fielded (no earlier than Fiscal Year 00) (LSDIS Acquisition Plan, p. 7, 1990).

The LSDIS is a NDI system. It is intended to support rapid-deployment light and special divisions in low-intensity conflicts with early warning alerts of incoming threat aircraft. It is classified as an urgent, directed procurement to expedite its fielding (LEWDD Directed Procurement Memorandum, p. 1, 1990).

2. The LSDIS Acquisition Strategy

The LSDIS NDI acquisition strategy consists of a competitive procurement reflecting the FAAR's retirement, pursuit of the best technology available, and minimizing expected cost and schedule. The directed procurement "label" originated from the urgent need to field an early warning sensor to light and special division ADA units until a lightweight version of GBS could be deployed.

The LSDIS acquisition cycle began with the approval of the Lightweight Early Warning Sensors Required Operational Capability (the LSDIS's original ORD) on 22 June 1990 and the Directed Procurement of the Lightweight Early Warning Detection Device (LEWDD) Memorandum published 26 July 1990. These were based on the technical requirements of the U.S. Marine Corps LEWDD program. The directed nature of the LSDIS procurement emphasized an accelerated solicitation and source

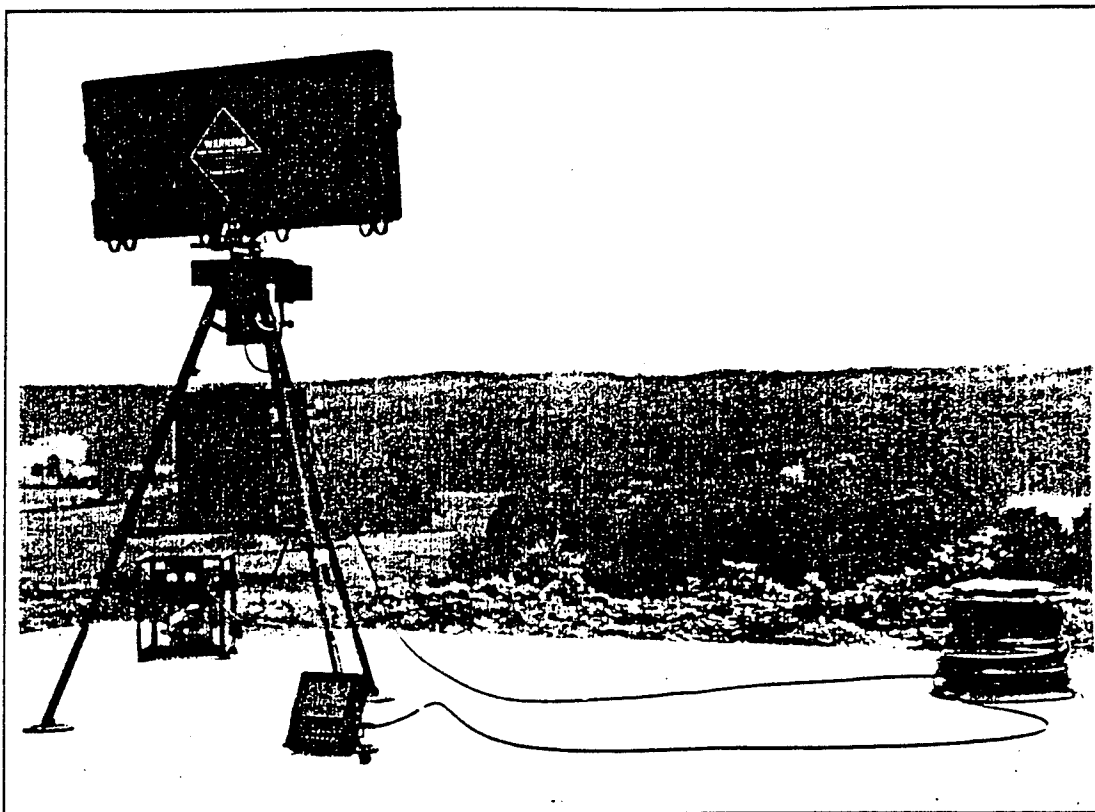


Figure 5 The Light and Special Division Interim Sensor

selection process (LSDIS IPS, p.4, 1993).

The FAAD Sensors PM recognized that not all system requirements would be met. This was particularly true with objective requirements. Proposal evaluations were based on best value and considered tradeoffs between objective performance requirements and current technical capabilities (minimum requirements), cost, and schedule (LSDIS AP, p.10, 1990).

The LSDIS RFP was released on 30 July 1990. Lockheed Sanders and Lear Siglar were the only bidders. The LSDIS program emphasized a streamlined NDI approach that allowed the Government to rapidly meet its urgent need. The competition emphasized that bidders provide reduced cost, efficient, and "best value" systems. Lockheed Sanders was awarded the best value contract on 13 November 1990.

LSDIS product testing began after the contract award in May-June 1991. The LSDIS contract required a First Article Test (FAT) and a PQT after which additional production contract awards would be issued. The date of the first unit (to be) equipped (FUE) was late 1992 with fielding to be complete in 1994 (LSDIS AP, p.7, 1990). The LSDIS FAT was successfully completed during 1 July 1991-15 November 1992 with the PM conditionally accepting the first unit. The PQT occurred from 2 March-7 May 1992. The LSDIS failed to meet operational requirements and system specifications due to false target rates, reliability-availability-maintainability (RAM) shortfalls, and azimuth alignment problems. A second PQT initiated on 7 June 1993 revealed all shortfalls were corrected and no further operational failures were exposed. The contractor's inability to meet operational requirements resulted in higher production costs and schedule delays of one year (LSDIS IPS, p.10, 1993).

The LSDIS NDI acquisition strategy required that production begin only after successful PQT completion. The LSDIS directed acquisition authorized limiting specification standards, test plans, and contract data requirements in its RFP as a means of saving costs. Waivers of those items designated as non-cost effective contract requirements were intended to shorten the program's duration. The acquisition strategy stressed "streamlined" program planning, testing, and ILS (LSDIS IPS, p.10, 1993).

E. RISKS AND RISK PERCEPTIONS IN THE FAADS SENSORS PROGRAMS

1. GBS Acquisition Program

a. Technical Risks

The revised requirements published in the GBS resolicitation reflected the Government's best value approach.

New minimum operational requirements allowed the contractor to make tradeoffs in technical and performance capabilities. The GBS design was simplified as a two-(azimuth and range only) rather than three-dimensional radar to meet cost and schedule objective requirements (Eison, 1994). Warranties for reliability and performance of accepted units assured compliance with all minimum requirements. The PM rated GBS technical risk as low to moderate for meeting minimum requirements (GBS Acquisition Plan, p.9, 1990).

The PM rated the risk of meeting technical performance objective requirements broadly as being low to high. This rating encompassed the known, current technical performance of the radar (based on minimum requirements) while accounting for unknowns in future, P³I-based radar performance (objective requirements).

b. Cost Risks

The PM rated the GBS cost risk as low to moderate. The GBS design was based on the Firefinder configuration which initially reduces the development requirements and costs. Schedule and performance risks are also dampened by the mature design. The cost risk rating considers the range of possible performance capabilities and contracting costs resulting from a best value approach. Cost history and production experience with the AN/TPQ-36A Firefinder indicate low cost risks in production. The GBS PM used a Firm-Fixed-Price (FFP) contract to contain Government cost risks. The PM's conclusion was that a NDI acquisition strategy would procure the best technology available. A reasonable contract price was expected through the competitive bidding process (GBS AP, p. 10, 1990).

The PM raised the GBS cost risk to moderate when the P³I program was added. These cost risks reflected research

and development (R&D) and design modifications required to achieve objective performance requirements. They also consider a different contract type. Hughes Aircraft Corporation would expect a Cost-Plus contract to cover its R&D costs and higher risks assumed in attaining higher objective performance requirements. If Hughes or a competitor agreed to a FFP contract (given that some P³I developments have existing technological solutions), cost risks would be lower for the Government and moderate (rather than high) for the contractor. GBS's objective performance requirements would be pursued early in the acquisition cycle if additional funding were approved for the GBS P³I program (GBS AP, p. 11, 1990).

c. Schedule Risks

The PM rated the GBS schedule risk as low for meeting a two year delivery schedule for a first production sensor upon contract award. Market surveys supported this assessment. Surveys revealed the risks of late fielding due to completion of a P³I program increased schedule risks to a range of moderate to high. The PM intended to pursue mature technology as part of the P³I. Schedule risks involving the completion of the longer-range P³I program depended on the increased technological complexity of the sensor and expected costs to achieve those objective performance requirements (GBS AP, p.11, 1990).

d. Supportability Risks

The PM's management of supportability risks is based on acquiring a validated technical data package (TDP). The purchase of a TDP is intended to reduce risks concerning future repair parts by Government ownership of technical documentation. Future repair parts procurements could then be

competed to find adequate support contractors to provide uninterrupted parts over the systems entire lifecycle (GBS AP, p.11, 1990). No risk rating was assigned to system supportability risks in the GBS Acquisition Plan. See Figure 6 for the GBS Risk Assessments.

2. LSDIS Acquisition Program

a. Technical Risks

The PM rated the LSDIS technical risk as low to moderate. As with the GBS, the LSDIS program followed a best value acquisition approach. This approach allowed the PM, armed with market survey results, to compete the procurement. However, LSDIS performance would be tested during sensor production. The contractor would warranty reliability and the fielded systems' performance after acceptance. Risk assessments would be based on FAT and PQT results (LSDIS AP, p.11, 1990).

b. Cost Risks

The PM rated cost risk as low based on the LSDIS FFP contract and competitive procurement strategy. LSDIS system configurations represent low cost risk with existing cost history and production background already established. Price again was a factor in the best value approach to reduce the Government's cost risks. Price considerations under a competitive NDI acquisition strategy was not anticipated to raise cost risk above a low rating (LSDIS AP, p.11, 1990).

<u>FUNCTIONAL AREA</u>	<u>RISK ASSESSMENT</u>	<u>CRITICAL RISK AREA/COMPONENT</u>
<u>System Performance</u>	Low	Acquisition/tracking of UAV, system false track rate
<u>Reliability</u>	Low	Soldier-machine interface
<u>Maintainability</u>	Low	Maintenance manuals
<u>Safety</u>	Low	Remote control terminal system generator
<u>MANPRINT</u>	Low	Soldier-machine interface
<u>Transportability</u>	Low	System weight for transport by utility helicopter
<u>Survivability</u>		
ARM Survivability	Moderate	Sensor - Exit Criteria
Direction-Finding	Low	Sensor - Exit Criteria
<u>Technology</u>	Low	Radar signal/data processor - incorporate VLSI technology
<u>Design and Engineering</u>		
Configuration	Low	Sensor - modify to be towed by HMMWV
Hardware and Software	Low	Radar signal/data processor - incorporate new radar interface
	Low	Software - re-host on new processor
<u>Manufacturing</u>	Low	Sensor, signal/data processor - part obsolescence
<u>Electromagnetic Compatibility</u>	Low	Radar set
<u>Environmental Effects</u>	Low	All hazardous/harmful materials used in manufacture or maintenance
<u>Support</u>		
System Generator	Low	Acquisition
<u>Cost</u>	Low	
<u>Schedule</u>	Low	
Delivery	Low	NDI sensor within 24 months

Figure 6 The GBS Risk Assessments (Source: GBS IPS, 1994)

c. Schedule Risks

The PM rated schedule risk as being moderate based on the urgent and accelerated schedule. The contractor was expected to meet LSDIS's directed procurement fielding dates one year after contract award (LSDIS AP, p.11, 1990).

d. Supportability Risks

No description of LSDIS supportability risks or risk reduction measures is in the LSDIS AP. Support is rated as moderate in the LSDIS IPS Risk Assessment. The 1990 LSDIS Light Sensor Market Study did not address contractor logistics support. See Figure 7 for the LSDIS Risk Assessments.

F. THE FAAD SENSORS RISK MANAGEMENT PROGRAM

1. FAAD Risk Management and DOD Policies

The FAAD Sensors PM believes NDI acquisition strategies equate to risk mitigation (FAAD Sensors PMO, August 1994). Both the GBS and LSDIS risk management programs demonstrate the characteristics described by DODD 5000.1 and DODI 5000.2. Both the GBS and LSDIS risk management programs outlined performance, cost, and schedule risks. Supportability risks are mentioned in passing. The FAAD Sensors PM used a streamlined risk identification, assessment, and reduction process as a risk management program. The GBS and LSDIS risk identifications and ratings and their rationale are simple and direct.

DODI 5000.2 does not explicitly outline a NDI risk management program for NDI PMs. Army Regulation (AR) 70-1 makes no explicit connection between NDI and risk management. No quantified or qualified risk analysis accompany the GBS and

Risk Assessment

Light and Special Division Interim Sensor (LSDIS)

1. Risk Assessment

<u>FUNCTIONAL AREA</u>	<u>RISK</u>	<u>JUSTIFICATION</u>
<u>Threat</u>	Low	LSDIS STAR
<u>Technology</u>	Low	No state-of-the-art technology used
<u>Design and Engineering</u>		
Hardware	Low	Proven in PQT II
Software	Low	Proven in PQT II
Manufacturing	Low	Proven in PQT II
<u>Support</u>	Moderate	Low density Contractor depot in place Depot contract award planned for Oct 93 No Direct Support or General Support Maintenance
<u>Cost</u>		
Production	Low	FFP
Support	Low	Contractor depot in place
Funding	Low	In Army budget
<u>Schedule</u>	Moderate	Tight schedule for 101st AASLT fielding

Figure 7 The LSDIS Risk Assessments (Source: LSDIS IPS, 1994)

LSDIS risk assessments to explain how they were obtained. Consideration of NDI-specific risks in requirements, specifications, T&E, and ILS are not evident. This is because existing policy does not describe how specific a streamlined risk management approach must be, let alone refer to any NDI-specific risks. DOD policy provides no NDI risk management references for NDI PMs to cite. Due to this lack of guidance, NDI solutions to urgent needs and force readiness gaps can lead to incomplete risk management programs. PMs may tailor developmental item risk management guidelines and risk assessments formats found in DODI 5000.2 and DOD 5000.2-M to suit NDI program needs. However, tailoring developmental risk management policies does not assure successful NDI risk management.

The NDI GBS and LSDIS programs constitute tailored, streamlined acquisitions of mature technology according to DOD and Army streamlining guidance. The FAAD Sensors PM's risk management practices incorporate tailoring and streamlining in his simplified identify-assess-reduce structure. The GBS acquisition strategy indicates that "the Army prefers to buy systems already designed, developed, tested, and in production, or at least where principal components are in production" (GBS IPS, p.C-4, 1994). Any risks involved with such an approach are not covered in an Army policy or memorandum, despite NDI's popularity in Army acquisitions.

DOD 5000.2-M does not outline a NDI risk assessment format. The GBS and LSDIS risk assessment formats are broad but follow the developmental risk assessment structure found in DOD 5000.2-M. Any application of DOD 4245.7-M risk identification and assessment procedures to the indicated GBS and LSDIS cost, schedule, performance, and supportability objectives are tailored or overlooked. The DSMC Risk Management Guide and the AFAM similarly do not cover NDI risk management policy, plans, or risk assessment formats. These

possible risk management references are not mentioned in the GBS or LSDIS risk management documentation.

2. The GBS Risk Management Program

The GBS risk management program's risk descriptions in its acquisition plan and risk assessments in its IPS meet minimum DOD policy requirements. The GBS risk management program uses the DOD 5000.2-M risk assessment format. The GBS's risk management program meets policy requirements by articulating risk planning, assessment, and reduction measures.

The PM implemented technical risk reduction by using a two-tiered approach to technical performance. The two tiers are minimum and objective technical performance. A system had to perform within this range to meet the Army's minimum requirements. The GBS contract bidders would then be considered as qualified potential candidates. The PM's market surveys indicated low risk of meeting the minimums. Higher risk requirements were designated as objective or "desired" requirements rather than setting them as minimums as in the original RFP. Technical risk was reduced using testing during source selection. Production contract options would not be exercised unless pre-production systems completed technical tests successfully. These measures reduced risks in fielding production units which did not comply with warranties on required performance levels (GBS AP, p.10, 1990).

To meet objective or "desired" requirements meant the PM had received funding approved for a GBS P³I. The GBS P³I program is currently unfunded. This programmatic uncertainty accounts for the GBS configuration changes to the HMMWV prime mover (low risk), radar hardware and software performance modifications (moderate risk), and future-based radar modifications to support the GBS's projected role as a "common

corps sensor" (GBS AP, p. 9, 1990).

The risk of publishing unattainable requirements in the original solicitation created follow-on risks to GBS performance, cost, schedule, and programmatic objectives. The sole bidder to the original RFP, Hughes, did not meet the user requirements during candidate system testing. Effective market analysis may have revealed that the combination of multiple systems' characteristics stated in the ORD did not exist in any one radar configuration. A complete market analysis could have indicated problems with the original requirements in 1985.

The new ORD and resolicitation of the GBS contract began four years later. The competition for contract award was not completed until 1991. Six years in schedule were added. The program management costs now included the resolicitation and re-evaluation of candidate radars based on a new ORD. The new schedule extended far beyond the retirement date of the FAAR and a FAAD EWN capabilities gap developed. The GBS's objective performance requirements now hinge on unfunded product improvements. The impact is seen in the PM being forced to trade off objective performance in order to expedite fielding a radar with the minimum required performance capabilities. The programmatic risks were realized when DOD decreased production funding and the number of systems it would buy from 77 to 57 in 1994 (Department of the Army ADA Highlights Memorandum, p. 6, June 1994).

The GBS NDI acquisition strategy emphasizes the benefits of NDI streamlining described earlier. Although **minimum** performance requirements were met during SSET, the GBS best value procurement did not meet all **objective** performance requirements. The PM and user accepted technical performance trade-offs. These decisions concentrated on performance that maximized mission support of FAADC³I and cueing FAAD weapon systems rather than maximizing GBS radar performance.

Deferred performance objectives may cause delays in procuring GBS P³I longlead items and eventually result in a production stoppage.

The problem with a production stoppage is that resulting production line layoffs, retraining, facility overhead costs, and start-up costs risk further schedule delays and cost escalation to both the prime and subcontractors (GBS IPS, p. C-7, 1994). The traditionally low-risk NDI cost and schedule features have also contributed to greater technical performance and programmatic risks for the GBS program. The PM was forced to "broad brush" the technical performance risk rating based on the uncertainty created by an unfunded P³I program.

The FAAD Sensors PM currently waits for additional funding approval to incorporate product improvements into the GBS configuration. Without the improvements, the ADA branch fields a minimum-capabilities system, delays procurement of long-lead items, and faces possible production shutdowns. With the improvements, the GBS schedule grows again, incurs more costs spread over fewer systems, and ADA endures more pressure to sell the program and justify its need.

The PM planned to reduce GBS cost risks based on the type of contract awarded for both production and P³I. Pre-production and production contracts were FFP with performance warranties. The contractor assumed the cost risks. The Government could reject options that were too risky. A Cost-Plus Incentive Fee award would be based on levels of proposed performance compared to desired requirements (GBS AP, p.11, 1990). Cost containment decisions in not exercising product improvement options and the use of a FFP contract limited Government risk and enhanced program support in the short term.

The PM's schedule risk reduction effort relied on the best value NDI acquisition strategy. Potential contractors'

proposals considered production and delivery schedules. GBS schedule risks were decreased by restricting production starts until the completion of the pre-production program. This risk reduction measure had its own drawback, however, of extending the program's length over an unacceptable period of time (GBS AP, p.11, 1990).

Supportability risks were assessed with limited depth. The Firefinder radar has a previously established support structure, supply and parts channels, and a training support package. While these could be tailored to the GBS fielding, support, parts flow, and training programs must be oriented to FAAD missions and roles.

Risk minimization by the FAAD Sensors Program Office considered other components besides objectives. The best value competitive acquisition strategy incorporated proposed contractor risk reduction measures into the source selection evaluations and contract proposal evaluations. The PM's test program includes a logistics demonstration in conjunction with operational testing to verify ILS capabilities and support concepts.

3. The LSDIS Risk Management Program

The LSDIS acquisition program's risk descriptions in its acquisition plan and risk assessments in its IPS meet minimum DOD policy requirements. The LSDIS risk management program generally follows the DOD 5000.2-M risk assessment format. The waiver of non-statutory requirements (due to its urgent and directed procurement classification) reflects the more simplified and less detailed risk assessment structure.

The PM employed a LSDIS technical risk reduction effort similar to the GBS program. The Army's performance requirements spanned the range of essential requirements and desired capabilities. Minimum performance requirements consisted of capabilities and characteristics needed by the

user. Capabilities described in contractor proposals that exceeded the basic requirements were considered objective performance requirements. The LSDIS contract awardee would be selected based on the best value of a proven NDI capability. This technical risk minimization complemented the production readiness assessment during which the bidders would "prove out" their production units in actual demonstrations. The production assessment would be reinforced by the FAT and PQT (LSDIS Acquisition Plan, p.11, 1990).

Risk reduction in the LSDIS acquisition concentrated on technical and cost risk. Schedule risks, although classified as moderate, were accepted based on the urgent, directed procurement. The limited quantity and urgent procurement classification allowed maximum use of waivers for all nonstatutory requirements (LSDIS Acquisition Plan, p.12, 1990).

The LSDIS requirements risk evolves from the use of Marine Corps requirements. The LEWDD Memorandum which served as the basis for the LSDIS requirement was followed by a short market analysis but, like the original GBS solicitation, drew only one bidder, Lear Siglar. With competition and best value common themes in NDI acquisitions, the contract was amended to include a competitive procurement and interoperability with FAADC³I at the direction of the Army Acquisition Executive (LSDIS Quick Report, 1993). These changes delayed the solicitation, added competition factors (which Lockheed Sanders then won, largely on the merit of its proposal (Eison, 1994)), and entailed greater market analysis of contractor testing and support capabilities.

Test and evaluation and specifications and standards risks surface with the emphasis on an urgent LSDIS NDI procurement. The directed procurement streamlined and waived certain aspects of the program and its documentation. The accelerated LSDIS acquisition program conducted performance

and design testing after contract award rather than during candidate evaluations. This did not allow for verification of system performance, production capabilities, or support structures until after manufacturing began. Once testing did begin, the contractor's design did not meet specifications during PQT. Operational requirements were not met. Integration and interoperability with FAADC³I were also overlooked in the requirements. Integration with the other components of FAAD battalions emerges as a performance specification issue as well. Market analysis with greater depth may have preempted these shortfalls.

The LSDIS NDI acquisition management environment entailed greater risks than anticipated. Test and evaluation, specifications and standards, ILS, requirements, and NDI acquisition planning were streamlined to meet cost and schedule objectives. LSDIS technical performance has suffered. Despite the streamlining steps, which were well known to all LSDIS acquisition participants, the contractor's product difficulties caused schedule slippage and cost increases. The short term gains will be justified only if the amended portions of the LSDIS acquisition cycle do not return to haunt the PM. The LSDIS remains fully funded for 40 sensors (Department of the Army ADA Highlights Newsletter, p. April, 1994)

The urgent nature of this NDI procurement, similar to the GBS, required more strict risk management. The accelerated NDI acquisition strategy jeopardizes the ease with which program objectives are expected to be accomplished. Test and evaluation and integrated logistics support plans may be rushed to completion for the sake of cost and schedule objectives. The verification of performance and support requirements in accordance with pre-determined specifications and standards may become paper drills rather than evaluations. Market analysis may also be caught in this compressed

acquisition cycle, and critical performance, production, ILS, and program issues may be overlooked.

4. The FAAD Sensors Risk Management Plans

The FAAD Sensors PM did not publish risk management plans for either GBS or LSDIS. A risk management program does not imply the existence of a explicit risk management plan (RMP) to outline the program. Risk planning, as required by DODD 5000.1 and DODI 5000.2, does not require a PM to release an RMP. The decision is left to the PM. Tailoring a NDI acquisition strategy to meet program requirements allows the PM to forego a published RMP. Tailoring, however, leaves a program vulnerable to NDI-specific risks in requirements, ILSP, T&E, S&S, and the NDI acquisition management environment. These contribute to risks in its cost, schedule, performance, and supportability objectives.

The absence of DOD or Army NDI risk management policy or outlines leaves the burden on the PM. The DSMC's proposed RMP outlined in its Risk Management Concepts and Guidance publication assumes a developmental program application. It neglects the risks and risk management needs unique to the NDI acquisition program. The AFAM likewise overlooks the needs of NDI PMs implementing risk management policy.

Assistance to NDI system PMs in the form of NDI risk management templates, sample NDI RMPs, and specific DOD and Army NDI risk management policy would facilitate NDI risk management practice. These measures would also counteract PMs' inclinations to treat risk management in their NDI programs as a costly, time-consuming, non-value added effort. The desire to tailor and streamline developmental risk management policy rather than work with explicit NDI risk management guidance leaves the PM free game to auditors, evaluators, and stakeholders in a NDI acquisition environment

that may grow less forgiving. The NDI templates and RMPs would serve as readily available tools to quickly and effectively assemble productive risk management programs that successfully grasp and control NDI risks. Improved DOD and Army NDI risk management policy would reinforce their legitimacy.

The ADA's FAAD doctrine depends on EWN. The FAAR retirement generated a credible mission need. The need was approved by the Army. Requirements were specified to meet the urgent needs. The Gulf War highlighted the pursuit of timely system fielding (programmatic risk). However, the original GBS requirements were not well written and reflected insufficient market analysis into available early warning radar technology (requirements and market analysis risks).

The GBS and LSDIS NDI early warning radars provided initially attractive solutions to ADA's FAAD and force readiness gaps. Early operational assessments, SSETs, FATs, and PQTs, however, uncovered weaknesses in both sensor designs that confirmed best value for the Government but did not yield desired performance (T&E and technical risk). The accelerated acquisitions had rushed the "limited" research and development process to meet urgent fielding requirements at the expense of confirmed, commercially-validated requirements and performance risk "multipliers" in T&E, S&S, and ILS.

G. SUMMARY

The GBS and LSDIS risks are described by the PM in terms of cost, schedule, performance, and supportability. Assessments and analysis of these risks are restricted to outlines since no RMP is used for either program. This is understandable in light of the DOD and Army policy voids and NDI tailoring flexibilities. The problem is that a "pick and choose" policy environment frustrates a PM's definitive efforts to build an effective risk management program and to

write an explicit RMP. The pressure to buy NDI and ramrod commercial specifications and standards into contracts will only result in more tailoring and streamlining of RMPs. Urgent and best value labels put on acquisition programs will continue the RMP and risk management tailoring trend in NDI acquisitions. The cost and time required to staff RMPs will only be justified when better tools, policies, and incentives exist to prepare detailed risk management programs.

V. MERGING THE TWO PATHS INTO ONE

A. PURPOSE

The purpose of this chapter is to analyze DOD risk management policy as it stands and to propose changes that support NDI acquisition programs. The FAAD Sensors risk management lessons learned appear first in this chapter. The importance of these lessons is reinforced by examining the risk management policy and the lack of detail it provides concerning NDI. The chapter introduces a dendritic diagram that breaks down developmental and NDI risk management requirements. It then considers improvements to portions of DOD risk management policy concerning NDI risks. NDI risk management tools are offered that can help PMs in managing risks in their NDI acquisition programs. It includes the potential benefits in NDI risk management templates, risk management plans (RMPs), and watch lists. It looks at possible revisions to the steps in the NDI acquisition cycle. The chapter concludes with a summary of where policy and procedure changes will expedite and increase the value of NDI risk management programs and plans.

B. FAAD SENSORS LESSONS LEARNED IN RISK MANAGEMENT

Several lessons can be gained from the FAAD Sensors program in the realm of risk management. The FAAD Sensors PM manages the GBS and LSDIS NDI programs using DOD's developmental program-based risk management policies. The FAAD Sensors program risks are categorized by cost, schedule, and performance objectives. Supportability risks are briefly mentioned. Programmatic risks are not specified. The PM uses DODD 5000.1, DODI 5000.2, and DOD 5000.2-M risk management guidance in managing his NDI programs.

In both the GBS and LSDIS programs, the Acquisition Plans (APs) identify risks, rate them, and describe risk handling

and reduction. Risk assessments are furnished in the programs' Integrated Program Summaries (IPS) according to DOD 5000.2-M formats. The NDI acquisition strategy in itself is viewed by the PM as risk mitigation. With these risk management program characteristics established, the following lessons emerge:

1. The FAAD Sensors PM relied on developmental program-based risk management policy direction and instruction because no explicit DOD NDI risk descriptions, risk management policies, or risk management tools such as NDI risk templates exist.

2. The PM tailored and streamlined DOD risk management policy, risk assessment formats, and risk management tools to meet the demands of his NDI programs' needs. While executing his risk management duties prescribed by DOD, the PM is vulnerable to second-guessing by auditors and other critics because specific NDI policy references that could be useful to justify risk management decisions and actions do not exist.

Tailored risk management practices and streamlined risk management documentation are acceptable in NDI DOD acquisition management. This is true provided the PM's risk management process does not break down. In an era of constrained resources, smaller RD&A budgets, and significant pressures to contain risks and buy NDIs, unsuccessful NDI risk management programs spell program failure. More explicit NDI risk management policy would protect programs if it required structured risk management planning in the form of an RMP. PMs could also protect the validity of their risk management efforts by using and referencing templates, program-specific watch lists, risk models, or some combination of these tools. Thus, the PM could have a safety net while walking the NDI risk management high wire, with references and justification for risk ratings, assessments, and handling measures.

3. The GBS and LSDIS IPS risk assessments rate the majority of risks low while their APs describe risks in ranges (generally low to moderate). The lack of consistency might be related to the difference in publication dates of the documents that guided these assessments. GBS and LSDIS APs published in 1990; the GBS IPS in 1994; the LSDIS IPS in 1993. In NDI program management such as with the FAAD Sensors case, the PM introduces programmatic risk by classifying more than a few program risk areas as moderate or high. NDI hold the reputation of being low risk, and to rate risks otherwise may draw audits, criticism, more documentation and meetings, and unwanted stakeholder involvement. Uniformity of program risk reviews prepared by contracting officers in APs that then translates directly to the PM's risk assessments in IPSS reduces the need for such scrutiny.

This uniform treatment of program risks and the plans to manage them could be most appropriately gained through a published RMP which serves as a focal point for all risk management issues and actions. A published RMP can be easily referenced by IPSS and APs. The PM's RMP could then bind AP and IPS risk management material together. This decisionmaking support tool could remain as an available program management document from one milestone decision review to the next. Its proper use would require training and education in NDI risk management planning. Examples (see Figure 8 and 9) are shown on the accompanying pages.

4. The FAAD Sensors PM does not consider NDI sources of risk that could potentially affect successful achievement of cost, schedule, performance and supportability objectives. Requirements, NDI Acquisition Management Environment, Test and Evaluation, Specifications and Standards, and Integrated Logistics Support risks acute in NDI acquisitions are not recognized or anticipated in any GBS or LSDIS IPS or AP. This is because such risk areas are only now being identified.

1.	PART I - DESCRIPTION
1.1	MISSION
1.2	SYSTEM
1.2.1	SYSTEM DESCRIPTION
1.2.2	KEY FUNCTIONS
1.3	REQUIRED OPERATIONAL CHARACTERISTICS
1.4	REQUIRED TECHNICAL CHARACTERISTICS
2.	PART II - PROGRAM SUMMARY
2.1	SUMMARY REQUIREMENTS
2.2	MANAGEMENT
2.3	INTEGRATED SCHEDULE
3.	PART III - APPROACH TO RISK MANAGEMENT
3.1	DEFINITIONS
3.1.1	TECHNICAL RISK
3.1.2	PROGRAMMATIC RISK
3.1.3	SUPPORTABILITY RISK
3.1.4	COST RISK
3.1.5	SCHEDULE RISK
3.2	STRUCTURE
3.3	METHODS OVERVIEW
3.3.1	TECHNIQUES APPLIED
3.3.2	IMPLEMENTATION
4.	PART IV - APPLICATION
4.1	RISK ASSESSMENT
4.1.1	RISK IDENTIFICATION
4.1.2	RISK QUANTIFICATION
4.1.3	IDENTIFICATION SUMMARY
4.2	RISK ANALYSIS
4.3	RISK MANAGEMENT (HANDLING TECHNIQUES)
4.3.1	RISK REDUCTION MILESTONES
4.3.2	RISK QUANTIFICATION
4.3.3	RISK BUDGETING
4.3.4	CONTINGENCY PLANNING
5.	PART V - SUMMARY
5.1	RISK PROCESS SUMMARY
5.2	TECHNICAL RISK SUMMARY
5.3	PROGRAMMATIC RISK SUMMARY
5.4	SUPPORTABILITY RISK SUMMARY
5.5	SCHEDULE RISK SUMMARY
5.6	COST RISK SUMMARY
5.7	CONCLUSIONS
6.	PART VI - BIBLIOGRAPHY
7.	PART VII - APPROVAL

Figure 8 Proposed DSMC Risk Management Plan Format (Source: DSMC Risk Management Concepts and Guidance, Chapter 4, 1989)

Although there may be evidence of these risks in the two systems' test and evaluation master plans, systems engineering

I.	Introduction
1.	Overview
2.	Applicable Documents/Definitions
3.	Management Organization/Responsibilities
4.	Scheduled Milestones/Reviews
II.	Identification and Assessment
5.	Survey and Identification
6.	Risk Assessment Models
7.	Flow/Level Assessment/Treatment
8.	System Hierarchy and Risk Tree
III.	Analysis and Reduction
9.	Reduction Methods
10.	Analysis Methods
11.	Risk Abatement Plan
12.	Prototyping/Simulations/Tests
IV.	Appendices
A.	Survey Form
B.	Report Format and Content
C.	Assessment Tables/Graphs
D.	Plan Format and Content

Figure 9 DSMC's Systems Engineering RMP Format
(Source: DSMC Systems Engineering Management
Guide, Chapter 15, 1990)

master plan, and integrated logistics support plans, these considerations are not cross-walked with AP and IPS risk documentation.

These lessons are not cited at the FAAD Sensors PM's expense. They are learned with his help. Previous FAAD programs such as the Sergeant York, the Roland, and Air Defense Anti-Tank System were doomed by inadequate risk management programs whereas the GBS and LSDIS programs are consistent with what DOD risk management guidance requires in print. The FAAD Sensors NDI acquisition approach is consistent with the DOD SD-2 Buying NDI Guide which specifies market analysis, requirements development, solicitation, source selection, product assurance (specifications), T&E, and ILS procedures (Office of the Secretary of Defense for Production and Logistics, 1990). Any trade-offs made in staffing a tailored, streamlined NDI risk management program versus other program requirements is not the focus of this thesis. However, the FAAD Sensors case, like the SD-2 and

other DSMC and DOD publications, does communicate the impact of NDI sources of risk and their consequences in terms of fielding delays, performance shortfalls, cost increases, supportability concerns, and programmatic challenges (e.g. funding shortfalls that reduce the number of systems to be fielded, unfunded P³I, the push for CIDs over MILSPECS and MILSTDS). The ADA user community has as much impact on the control of these risk events as the PM. The PM's user has an obligation to effectively research and validate system requirements that directly affect its divisional tactical doctrine, force readiness, and potential combat capability gaps.

C. THE DIVERGING PATHS

The crux of the NDI risk management issue is that no risk management policy explicitly addresses NDI acquisitions. Risk management and NDI policy do not converge. DODD 5000.1 and DODI 5000.2 invite tailoring of their risk management policies to fit the needs of the individual programs. The implicit and somewhat erroneous assumption in these policies is that risk management is practiced for developmental programs with complete acquisition cycles. NDI programs do not correspond to these assumptions. DOD policies neglect NDI risks and risk management practices.

NDI acquisition risks are unique. They reflect accelerated, sometimes urgent procurements with abbreviated acquisition cycles to meet user needs and requirements. NDI acquisitions tailor and streamline acquisition policy and particularly, risk management policy, and make tradeoffs among program objectives. While NDI programs do mitigate risks in cost and schedule, their technical performance, supportability, and programmatic risks are heightened. The consequences of risk events in these areas can have tremendous

affect on cost and schedule in the long run. DOD's challenge is to bridge the gap between developmental acquisition risk management policy and practices and those that apply specifically to NDI risks. Effective application of NDI-based risk management policy and practice can save PMs valuable time, money, and manpower resources while assisting them in effectively meeting program goals and objectives.

Risk management programs and NDI solutions are popular acquisition issues whose paths must cross to serve the best interests of NDI PMs, their programs, and their customers. At present, however, the two paths lack any formal policy connection. The point is not to invite more regulation, but instead to appeal for official documentation and guidance that corresponds with today's acquisition environment and its emphasis on acquiring state-of-the-art technologies today as sources of tomorrow's Army systems. By updating and correcting the oversights in NDI risk management policy and guidelines, PMs can more quickly and accurately assemble risk management programs and concentrate on program objectives with an appropriate NDI risk management baseline.

D. A DENDRITIC APPROACH

DOD risk management policy exists in DODD 5000.1, page 1-4, and DODI 5000.2, Part 5B. The Army published its acquisition policy with references to risk management in Army Regulation (AR) 70-1. Its Department of the Army Pamphlet (DA PAM) 70-2 on Risk Management is due in February 1995. Army acquisition risk management policy implicitly corresponds to and mirrors that of DOD. Army risk management policy pertaining to NDI in AR 70-1 is not articulated despite the popularity of NDI acquisitions and Army NDI initiatives. DOD risk management policy according to DODD 5000.1 and DODI

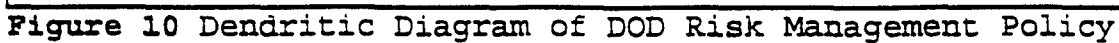
5000.2 relies officially on risk management tools such as templates outlined in DOD 4245.7-M and the AFAM and unofficially with DSMC's risk management plans, risk matrices, and watchlists found in its risk management guide. Army PMs likely will tailor DOD guidelines for implementing risk management to suit individual program needs.

A model such as a dendritic diagram can lay out the DOD risk management issue, its scope, criteria, measures of effectiveness and performance, and the rationale for NDI PMs to have more explicit risk management policy. PMs could then refer to NDI risk templates and other tools to facilitate effective risk management.

Operational and design requirements, NDI acquisition management, specifications and standards (for design and manufacturing of standard and non-standard parts), test and evaluation (including FATs, PATs, and PQTs) and ILS all represent significant NDI risk areas lacking templating in the DOD 4245.7-M and articulation in DSMC risk management plans. A dendritic layout of risk management policies and the need for NDI risk management guidance could be outlined as seen on the following page in Figure 10.

E. DOD POLICY REVISIONS

NDI PMs currently conduct risk identification, assessment, handling, and documentation according to DODD 5000.1 and DODI 5000.2. In doing so, the PM applies **developmental** acquisition risk management policy and procedures focusing on traditionally developmental program risks to **nondevelopmental** systems. The point is that, as seen with the FAAD Sensors PM, many NDI acquisition PM's are forced to "think on the move" without explicit directions or road maps. Lacking DOD or Army NDI risk management policy,



instructions, templates, or even unofficial emphasis in DSMC risk management publications, PMS will continue to rely on gut feelings, developmental lessons learned, and incomplete references. The approach of tailoring and streamlining developmental risk management policy and practice to suit NDI program requirements puts NDI PMS and their acquisition programs on a high wire without a net. Program risk management can easily be second guessed because no official references can be cited to justify risk management decisions. Lack of published NDI RMPs increases this risk exposure.

1. DODD 5000.1 Risk Management Policy

DOD's Acquisition Policy Directive 5000.1, Part 1 contains no explicit guidance directed to NDI risks and NDI risk management. The implicit developmental (as opposed to NDI) tone in the risk management policy has not kept up with the push to satisfy requirements using mature technology acquisitions from Government agencies and/or commercial sources. This necessitates risk management program requirements and references directed to NDI PMS.

The DODD 5000.1 contains six areas which could be revised to make its risk management guidance suitable for NDI PMS. The first area is in the risk management section description in Part 1. It presently states:

Program risks and risk management plans shall be explicitly assessed at each milestone decision point prior to granting approval to proceed into the next acquisition phase.

This guidance lacks reference to a definitive risk management planning structure. Currently, NDI PMS are expected to tailor the DODD 5000.1 risk management guidance to their NDI systems acquisitions. This leaves the PM's

interpretations of present policy vulnerable to second-guessing by auditors and program stakeholders such as the Army. The following could be added for more structural content to developmental and NDI risk management planning:

Every milestone decision point will include a review of the updated risk management plan (RMP) and measures taken to identify, assess, analyze, handle, and document program risks. Continuity will be maintained between the RMP and discussions of program risks in the Integrated Program Summary, Acquisition Plan, Systems Engineering Master Plan, Test and Evaluation Master Plan, and Integrated Logistics Support Plan.

The RMP would be modelled after the DSMC Risk Management and/or DSMC Systems Engineering Management Guides' formats, depicted in the DOD 5000.2-M, and tailored to the requirements of the individual program. It would require the "teaming" of the user and the PM to integrate a risk management focus with needs and requirements development.

The second area is subsection a. which describes critical parameters. This statement ignores the cost drivers in NDI programs: requirements, NDI acquisition management, T&E, S&S, and ILS. It directs the following:

a. Critical parameters that are design cost drivers or have significant impact on readiness, capability, and life cycle costs must be identified early and managed intensively.

The DOD 4245.7-M describes the areas of risk that jeopardize successful cost objective achievement. It does not describe NDI risks acting as cost drivers. The following could be added to reflect these NDI risks:

NDI programs shall include the effects of requirements, NDI acquisition management, Test and Evaluation, Specifications and Standards, and Integrated Logistics Support risks on cost objectives. Measures of effectiveness and

performance for risk handling shall be proposed in the RMP concerning these risks.

The third area of interest is subsection c. which discusses Test and Evaluation. It reads:

c. Test and Evaluation shall be used to determine system maturity and identify areas of technical risk.

NDI acquisition strategies often include accelerated and streamlined (depending on the quantity and quality of contractor test data) testing and evaluation processes or simply contractor test and evaluation data reviews. The risks in NDI acquisitions are testing too little, too much, and the right or wrong requirements. The following should be included to address these concerns:

NDI market analysis of proposed designs, NDI test and evaluation programs, and NDI performance specifications shall not be subject to trade-offs for the sake of short term cost and schedule objectives. Such trade-offs introduce risks to NDI lifecycle costs and support. NDI contractors' test and evaluation data shall be screened and validated independently by the operational test and evaluation community.

The fourth area is subsection d. which considers contractor responsibilities. It directs that:

d. Solicitation documents shall require contractors to identify risks and specific plans to assess and eliminate risks or reduce them to acceptable levels.

The reference to eliminate risks could be removed since no program objective or action is free of risk. The shortfall in this guidance on contractor risk management is the lack of parallelism between the NDI PM's risk management efforts and requirements and those of the contractor. The NDI risk

management efforts should emphasize teaming and sharing to relieve the burden of risk management from resting primarily on the Government. This is particularly true with the accelerated nature of NDI acquisitions. Risk responsibility should be shared by the contractor. The following could be added:

Contractor RMPs shall be specified in solicitations as a deliverable. These shall be consistent with DOD program managers RMPs. Risk sharing shall be emphasized by the DOD-contractor team.

The fifth area focuses on subsection e. which discusses the risk assessment format found in DOD 5000.2-M. The guidance and format make no mention of NDI risks. Risk assessments, while intended to be tailored, should be comprehensive in nature and include the full spectrum of risks expected as a NDI PM. The five NDI risks should be added to the DOD 5000.2-M format.

The final area of revision is subsection f. which reads:

f. Schedule shall be subject to trade-off as a means of keeping risk at acceptable levels.

The FAAD Sensors case demonstrates that trading off schedule to control risk implies accepting force readiness and doctrinal capability gaps. If no operationally effective replacement systems exist, then such trade-offs can have significant impacts on force training and combat effectiveness. The following clarification could be included:

Such trade-offs shall be made only in the event that current systems exist to sustain the force until the NDI are fielded.

The DODD 5000.1 risk management policy revisions are an important first step. Policy must clearly state the risk management requirements and guidelines as they specifically

affect a NDI PM's risk management program. These changes will provide impetus for revisions to DODI 5000.2 which will be examined next.

2. DODI 5000.2 Risk Management Policy

NDI PMs need more definitive and explicit policy and procedures in DODI 5000.2, Part 5B pertaining to their risk management programs. The DODI 5000.2, with its developmental item orientation, neglects NDI risk management. With increasing competition for shrinking DOD RD&A budgets and resources, DOD and Congressional risk tolerance will decline, pressure to manage programs according to sound business practices will intensify, and "safer" acquisitions will attract more support. In these circumstances, explicit NDI risk management instruction will become critical to NDI program management.

The two subsections in DODI 5000.2 could provide more definitive risk management guidance to NDI PM's and remove the "guesswork" required in tailoring developmental risk management policy. The first area is subsection a. No mention is made of supportability and programmatic risks in the reference to risk identification and control. These objectives typically encounter many risks in NDI acquisitions from risk events concerning requirements, NDI acquisition management, T&E, and ILS. Supportability and programmatic risks should be included in the discussion of acquisition program risks.

The DOD 4245.7-M templates referred to in the policy as a means of identifying and controlling risks are ten years old and list risk areas such as funding that are not matched or consistent with DSMC's five objective areas of risk. The templates have no NDI-specific content. The five areas of NDI risks should be explicit in the templates so that they

correspond to NDI risk guidance in DODI 5000.2. DOD 4245.7-M revisions will be discussed in the next section.

Subsection b. of DODI 5000.2 addresses industry participation in risk management. Currently, there is no explicit integration of contractor and PM risk management efforts. A contractor RMP deliverable similar to the plan published by NDI PMs binds the contractor to a risk management partnership with the PM. It should document and update how the program's risk identification, assessment, analysis, and handling processes would be conducted. This uniform standard would entail closer coordination or "teaming" of risk management actions.

3. DODI 5000.2 Risk Management Procedures

Three areas exist in DODI 5000.2 risk management implementation procedures that could better serve the interests of NDI PM's with more explicit discussion of NDI risks. First, the instruction, "include clearly defined criteria for elements leading to the risk assessment events... satisfaction of these criteria must be well documented to support the rigor necessary in the risk assessment process" highlights the policy void NDI PMs face in justifying their risk ratings and assessments. DOD 4245.7-M serves as the origin for the criteria described. Without existing NDI risk criteria, risk assessments have no basis or references to support them.

The second area of this procedures section concerns the risk assessment format in DOD 5000.2-M. The format description does more to encourage tailoring than to depict a specific risk assessment format; it provides little to support outlining an NDI risk assessment. The format would be more consistent if it were to correspond to the risk areas listed in the DOD 4245.7-M. Additionally, with NDI and streamlining

initiatives more common today, more detail is required in the supportability and programmatic sources of risk currently described in those sets of templates.

Finally, milestone decision point reviews discussed in this portion of DODI 5000.2 do not refer to one central document as the basis for risk management data and documentation of the planned risk management program. Reference should be made to a RMP as the source of documented program risks, risk assessments and analysis, risk reduction measures, rationale, and assumptions in the published risk ratings. This could be more effective than flipping between the IPS, AP, TEMP, and SEMP.

Alternative acquisition strategies, particularly NDI acquisition strategies, are often designed to mitigate certain risks. NDI acquisition strategies account for degrees of risk since they are based on procuring mature technology with abbreviated RD&A schedules and costs. The policy here should explicitly cite the NDI alternative, its streamlined acquisition cycle, and the parts of DODD 5000.1 and DODI 5000.2 in which detailed descriptions of NDI risks and risk management actions appear. For example, the following parts of DODI 5000.2 could feature the NDI risks, possible risk ratings and assessment considerations, and initial risk handling options as deliverables: Part 4 (Requirements), Part 6 (Test and Evaluation), Part 7 (Integrated Logistics Support), Part 9 (Specifications and Standards), and Part 11 (NDI Acquisition Management). Risks, particularly NDI risks, could then be distinguished from developmental features in each of these parts of the DODI 5000.2.

F. DOD 4245.7-M TEMPLATES IMPROVEMENTS

The following are areas for revision in DOD's primary risk management tool, the risk templates. This would clarify

DOD's position on NDI risks and recommended risk management measures to the benefit of NDI PMs, their programs, and their customers.

1. Requirements Risks

NDI risk management templates should begin with requirements risk. Requirements risk should be identified and assessed first, prior to considering a program's risks to its cost, schedule, technical performance, supportability, and programmatic objectives. Identifying and assessing requirements risks controls its potential impact on technical performance, cost, schedule, and performance specifications from stalling an NDI program's early progress. NDI requirements must include integration and interoperability of the NDI with developmental items and the corresponding risks of failing to effectively integrate and interface. An example would be the risk of LSDIS not having interoperability with FAAD command and control nodes and fire units such as Avenger because that requirement was not concretely established.

Inserting market analysis into the acquisition cycle and screening requirements development against what actually exists in the market would limit unrealistic requirements appearing in RFPs. The market analysis step should be specified in policy as a step initially occurring between preparation of the MNS and the ORD. This would facilitate NDI solutions to user requirements and support sound NDI acquisition strategy development based on a clear picture of current industry technology rather than nonexistent, desired capabilities of multiple systems blended together. The category of NDI would also be clearly identified such that source selection evaluation test results concerning assessment of technical performance would not necessitate redesign and recompetition of requirements and potential designs.

2. Requirements Risk Template

AREAS OF RISK:

Operational and Design Requirements that are ill-defined or overlook NDI alternatives.

Inadequate Market Analysis that contributes to "mix and match technologies being required rather than verification of what technology actually exists.

Tradeoffs in minimum and objective performance requirements that fail to meet the user's stated need.

Improperly defining the proposed system's NDI category and required design modifications.

OUTLINE FOR REDUCING RISK:

1. Insert NDI Market Analysis into the acquisition cycle as part of Phase 0, Concept Exploration and Development.
2. Apply PM - user teaming to better screen and develop requirements.

TIMELINE: All Phases

3. Specifications and Standards Risks

NDI risk management policy should emphasize which specifications and standards, CIDs or MILSPECS, that NDI procurements will comply with. Secretary of Defense William Perry is on record as requiring the use of commercial specifications and standards rather than MILSPECS and MILSTDS (Secretary of Defense Memorandum on Specifications and Standards, p. 1, 1994):

Use performance and commercial specifications and standards in lieu of military specifications

and standards, unless no practical alternative exists to meet the user's needs.

The DODI 5000.2 clearly states the waiver required to use MILSPECS and MILSTDS over CIDs found in the Uniform Commercial Code. DOD policy on technical risk reduction by using mature NDI systems and their corresponding mature commercial specifications and standards can assist PM's and simplify contractor compliance. Rather than specifications that specify system, design, and manufacturing functions and steps, the use of performance specs based on form, fit, and function in place of the current "how-to" specs better suits mature technology found in NDI. Such a change would facilitate contractor responsiveness to RFP requirements and draw more competitors to the bidding process. A larger sample of industry alternatives, as witnessed in the re-competition of the GBS contract and validated in SSETs, encourages competitive systems and prices. Using CIDs would replace the red tape NDI systems face in complying with developmental MILSPECS and MILSTDS.

4. Specifications and Standards Risk Template

AREAS OF RISK:

Technical performance in commercial applications as specified in CIDs may not equate to or explicitly meet technical performance in military applications as stated in MILSPECS and MILSTDS after an NDI acquisition strategy is already approved.

Performance S&S based on form, fit, and function (that allow contractors to design solutions) instead of the "how-to" MILSPECS and MILSTDS used in design and manufacturing may encounter workforce resistance or complacency.

Inadequate market analysis leads to accepting products

with insufficient or undocumented technical data or CIDs with which to re-compete the procurement for future buys.

OUTLINE FOR REDUCING RISKS:

1. Specify in solicitations that CIDs for meeting user requirements are a deliverable.
2. Evaluate the CIDs against MILSPECS to verify their adequacy for design and development.
3. Train and educate the acquisition workforce in CIDs and commercial specifications.

TIMELINE: All Phases

5. NDI Acquisition Management

NDI acquisition management risks impact programmatic, cost, and schedule objectives. NDI risk management policy should redirect risk management responsibilities to be borne primarily by industry, or at least equally shared. Since NDI is mature technology, the developmental program risks assumed by the PM and the Government no longer apply. With CIDs on hand and effective market analysis verifying qualified contract bidders, the RFP and SSET processes become much simplified.

Changing developmental program paradigms to NDI remains an acquisition community challenge. NDI alternatives can become more acceptable to the acquisition workforce with revised risk templates and detailed articulation of NDI risks. Streamlining risk management paperwork requirements would be best instituted by using RMPs and improved education. In addition, delegating reviews of program risks to lower levels of the acquisition chain of command would speed risk

management actions.

The integration of civilian technologies into the military demands that contractor risk management programs and plans be explicitly required items in RFPs. NDI acquisition management requirements mandates parallel NDI risk management policy and references for both industry and PMS.

6. NDI Acquisition Management Risk Template

AREAS OF RISK:

Despite streamlining, paperwork requirements, pricing data, accounting requirements and continuous audits of NDI programs stifle the cost and schedule objectives laid out in the acquisition strategy.

Traditional developmental program attitudes and developmental program "mindsets" continue to reflect a cultural resistance toward implementing timely and cost-effective NDI acquisition strategies.

Lack of PM-contractor and user-PM teaming on risk responsibility and risk sharing hampers flexibility in risk management efforts.

Programmatic micromanagement by stakeholders defeats the benefits of an NDI acquisition strategy.

OUTLINE FOR REDUCING RISKS:

1. Require RMPs as a contractor deliverable.
2. Require workforce training and education in NDI through DSMC.

TIMELINE: All Phases

7. Test and Evaluation

NDI Test and Evaluation risks impact performance, cost, schedule, and supportability objectives. NDI risk management policy must address the accelerated T&E program for validating component and system performance in operational testing. An NDI evaluation would be expedited with a test-fix-retest (FAADS PMO, 1994) cycle rather than the extensive documentation that goes into describing all the system faults prior to a rescheduling a test. Technical performance and design risks as well as confirmation of compliance with realistic specifications and standards, requires more detailed testing of the product and production process than implied in the NDI mature technology "label".

8. Test and Evaluation Risk Template

AREAS OF RISK:

Requirements are not stable, realistic, or well-understood by designers, developers, testers, or managers.

Overtesting conducted despite the presence of satisfactory contractor test and evaluation data package.

Developmental/technical testing costs are saved but operational testing for operational effectiveness and suitability may involve conditions not grasped by contractor testing program. These incomplete tests and/or data may be overlooked or unquestioned in the accelerated NDI acquisition cycle and corresponding accelerated NDI testing program.

OUTLINE FOR REDUCING RISKS:

1. Test and evaluation data reviews of contractor commercial testing program and results.

2. Demonstrations of the contractor's testing process.
3. Test-Fix-Retest the proposed design on site to expedite testing.

TIMELINE: All Phases

9. Integrated Logistics Support

NDI ILS risks affect cost, schedule, performance, and supportability objectives. NDI risk management policy on logistics planning risks entails the greatest need in improved DOD guidance. The supportability risk of contractor production and support operations terminating prior to a time convenient to the Government, mandates that options be specified in the ILSP and agreed upon by the PM and the contractor.

Options the PM can consider include those posed in DSMC's NDI Acquisition publication:

- a. Buy commercial upgrades as they evolve and become available.
- b. Make a one-time mass spares purchase to sustain the duration of the system's lifecycle.
- c. Buy the technical data package to solicit sources of supply that coincide with the end of original production and support by the original contractor.

Market analysis should reveal whether contractor technical data rights conflict with Government interests and whether longevity of profitable production lines pose risks to achieving supportability objectives. These should all be points of direction in DOD policy.

10. Integrated Logistics Support Risk Template

AREAS OF RISK:

Technical Data Packages may be unavailable or incomplete which creates instability of spares and parts access.

Competitive re-procurements of parts may not contain proper incentives to attract spares and parts vendors.

ILS and lifecycle focus may be overlooked during the requirements development stage.

Use of military standard and non-standard parts creates multiple parts and spares lines.

Depot/repair levels may not be defined in terms of operational environments.

OUTLINE FOR REDUCING RISKS:

1. Define ILS requirements when deciding what category of NDI the acquisition strategy involves.
2. Conduct market analysis of contractor ILS capabilities, ILS testing and support demonstrations in the intended operational environment and conditions.
3. Specify training packages and publications as a contractor deliverable.

G. SUMMARY

The NDI areas described above require timely DOD attention in DODD 5000.1, DODI 5000.2, and DOD 4245.7-M. These revisions are needed to adequately provide guidance to NDI PMs. The template diagram, the specific area of risk, an outline for reducing the risk, and a timeline for managing these risks within the system's lifecycle must be included.

Clarifying the risk management policy and corresponding templates with NDI implications would streamline the risk management process in itself by saving time and effort to staff who manage a risk management program. There would be no need for NDI interpretation of developmental item templates.

VI. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

A. SUMMARY

The subjects of risk management and NDI acquisitions are attracting more attention today. The individual emphasis on these two acquisition management areas is not matched by their effective integration. As a result, NDI PMs are conducting risk management programs that are themselves at risk due to the lack of current, explicit guidance from DOD.

The practice of risk management does not benefit from "cookbook" solutions. If such solutions existed for developmental acquisition programs, there are very few, if any, for NDI acquisition programs. This is the NDI PM's dilemma. The NDI PMs must adhere to DODD 5000.1 and DODI 5000.2 risk management policies in their programs, but the DOD material is vague or must be tailored to support NDI program needs. The FAAD Sensors case is a testament to the PM who drives a risk management program without the benefit of signposts or road maps.

The NDI PM's challenges and program risks in the mid-1990's are not adequately reflected in DOD's mid-1980's risk management policy, procedures, or tools. Risk management will receive more, not less, emphasis as an explicit management function. NDI and NDI acquisition strategies will continue to grow in popular support as DOD RD&A budgets "downsize". Modernization at minimum risk therefore will require properly marked signposts and a good road map. It is time for DOD to print and distribute those signs and maps.

B. CONCLUSIONS

NDI PMs continuously manage risk as part of today's streamlined and tailored NDI acquisition environment. They should expect and receive succinct, explicit policy and guidelines to help them meet their risk management and program

management goals and objectives. DODD 5000.1 could better serve the NDI PMs with risk management language directed to their specific type of programs and acquisition strategies. DODI 5000.2 could provide NDI PMs with both better risk management guidance and implementation procedures with NDI-based instructions, formats (to be found in DOD 5000.2-M), and tools (DOD 4245.7-M risk templates and risk management plan).

DOD 4245.7-M could introduce NDI as a topic and an area of templating as it is updated for today's acquisition environment. The risks uniquely significant to NDI acquisition programs can be better recognized, understood, and managed with a focal point known as a risk management plan.

Several common threads bind NDI and NDI risk management to immediate programmatic, performance, and supportability objectives and long-term cost and schedule objectives. Those threads are thorough market analysis, accelerated acquisition cycles, and teaming of the risk management effort between the PM and the contractor as well as the PM and the user. The acquisition environment and its intricacies may be changing but the demand for short-duration, cost-effective systems acquisitions will persevere.

C. RECOMMENDATIONS

DOD should upgrade the DODD 5000.1, DODI 5000.2, DOD 4245.7-M, and DOD 5000.2-M to incorporate the NDI risk management issues and proposed revisions discussed in this thesis. DSMC publications referring to risk management and the AFAM should be similarly revised.

Market analysis, risk management plans, teaming, and NDI acquisition training and education should be explicitly emphasized in DOD risk management policy. Market analysis should be specified as a deliberate step or phase conducted immediately after the release of the Mission Needs Statement. This may coincide with the Concept Exploration and Development

Phase. Risk management plans should be a required program management and decisionmaking tool that is published as the primary source of risk management program information such as: risks, risk ratings, risk assessments, risk analysis, risk handling and/or reduction measures, and risk data documentation. Other program plans would refer to the RMP as the consolidated reference point for program risk information. Teaming and education on NDI risk management should be directives required of all PMOs.

Risks in the following NDI sources of risk should be explicitly cited and referenced in DOD risk management policy: Requirements, Test and Evaluation, Specifications and Standards, Integrated Logistics Support, and the NDI Acquisition Management Environment. These sources create uncertainty in the successful accomplishment of NDI program objectives. They should be explored from both a NDI and a developmental perspective (based on the needs and requirements of the user).

DOD NDI risk management policy should stress RMPs, CIDs (for review and comparison to MILSPECS), Test and Evaluation program data packages and demonstrations, and Integrated Logistics Support Plans in NDI RFPs as contractor deliverables. These should be required up front and early in the accelerated NDI acquisition cycle and subject to frequent review based on their immediate and long-term lifecycle impacts on the system being acquired.

D. AREAS FOR FURTHER RESEARCH

1. Market Analysis of NDI Requirements. The importance of market analysis grows as DOD turns to the commercial marketplace for more immediate solutions to its needs. An analytical approach to evaluating NDI solutions is needed to replace the market surveys of the past. This is more relevant given the close ties and tremendous impacts well- or poorly-

done market analysis can have on requirements generation, selection of specifications and standards based on those requirements, and comparison of contractor test and evaluation results with those sought through DOD's developmental and operational testing programs. Market analysis also plays a significant role in determining contractors' ability to support their products throughout their lifecycles. A case study of NDI market analysis success story would prove valuable as a reference or model to all acquisition community players.

2. Successful Contractor RMPs (in the Context of Best Practices). The case analysis of one or several success stories in contractor risk management bears investigation, particularly in the NDI environment. The lack of DOD emphasis on risk management of NDI acquisition programs and supporting RMPs may be mirrored by a lack of commercial emphasis on the same area. Documentation of lessons learned in contractor risk management plans could offer valuable insights to the user community, PMS, and other contractors. Providing a contractor "best practices risk management model" could reinforce the importance placed on contractor RMPs as deliverables.

3. Risk Management in Foreign Military Sales and Foreign Military NDI acquisition programs. The risks encountered with acquiring NDI may represent only one category of emerging acquisition issues facing DOD. Risks and risk management practices in foreign procurements may have similarities to NDI acquisition programs. This is especially true with our national security strategy's increased focus on economic security and global competitiveness. The DTIB's vulnerability to not only national NDI alternatives but international NDI may provide more justification for dual-use products to improve competitiveness and mitigate RD&A risks. The risks and risk management practiced in foreign acquisition

programs will become more complex and may require more detailed DOD risk management policy in foreign technology acquisition programs.

4. The DOD Developmental Acquisition Program Community's Ability to Cope with the Rising Tide of NDI and Commercial Practices. The cultural biases and mindsets towards developmental programs described in this thesis must face the rising tide of NDI much like the DTIB faces increased competition for shrinking RD&A dollars. Changing attitudes and program management paradigms in the acquisition community has tremendous time, resource, and personnel implications. Streamlining and tailoring the DOD acquisition process emphasizes immediate, mature, and cost-effective NDI alternatives. It may be important to examine the training and education programs being used to facilitate NDI acquisitions, NDI risk management, and acquisition community responsiveness to a changing acquisition environment.

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